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Report FESA-RT-2030

PRELIMINARY DESIGN OF A TOTAL UTILITY PILOT DEMONSTRATION PROJECT AT A REGIONAL STANDARD EM BARRACKS COMPLEX FORT BELVOIR, VA

Gamze-Korobkin-Caloger, Inc.
205 West Wacker Drive
Chicago, Illinois 60606

410161

15 September 1976

Final Report

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Prepared for

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A Total Utility (T.U.) preliminary design is to be implemented at any 1200 man Regional Standard E.M. Barracks Complex and generated from the 1200 man Regional Standard E.M. Barracks located at Fort Belvoir, VA; incorporating the materials, methods fabrication and construction practiced at this site. This preliminary design incorporates the following:

(1) T.U. plant that can supply the entire site with electricity, space heating and cooling. -> next page

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cont. (2) An advanced technology sewage treatment facility interfaced with the total energy section for disposal of sludge and primary clarified effluent.

(3) An incinerator for disposal of barracks and mess facility burnable trash interfaced with the TU plant through heat recovery and thermal storage facilities.

(4) Major equipment selections for the T.U. plant.

(5) All demand load profiles for the site.

PRELIMANARY DESIGN OF A
TOTAL UTILITY SYSTEM
PILOT DEMONSTRATION PROJECT
AT A REGIONAL STANDARD
EM BARRACKS COMPLEX
FT. BELVOIR, VIRGINIA

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APPENDIX

Chapter I

Introduction

Load Analysis Information Report

Load Analysis Information

Task

"Prepare the load analysis information in a textbook-model problem format. This format is to allow for extrapolation to other sites and building complexes.

Model Problem

A Total Utility (T.U.) preliminary design is to be implemented at any 1200 man Regional Standard E.M. Barracks Complex and generated from the 1200 man Regional Standard E.M. Barracks located at Fort Belvoir, Va.; incorporating the materials, methods fabrication and construction practiced at this site. This preliminary design incorporates the following:

a. T.U. plant that can supply the entire site with electricity, space heating and cooling.

b. An advanced technology sewage treatment facility interfaced with the total energy section for disposal of sludge and primary clarified effluent.

c. An incinerator for disposal of barracks and mess facility burnable trash interfaced with the TU plant through heat recovery and thermal storage facilities.

d. Major equipment selections for the T.U. plant.

e. All demand load profiles for the site.

Electrical Profile

The first step in any Total Utility (TU) study is to make an analysis of the electrical loads throughout the site (per building). This data is then translated into profiles representing the variation of load demand during a 24 hour period for typical weekday and weekend occupancy. The profiles produced from the electrical survey are fairly representative of similar military installation; only the level of loads will vary. Fig. la, b,c and d are the calculated profiles for the entire site and were derived by analysing the electrical loads for each building, determining the building essential or base loads, selecting the typical profile slope for this site and then applying actual demand loads. The electric load profiles are an important key to this design since they lay the basis for selecting the number and size of engine generators and also determine the major portion of recoverable heat available to the plant.

Thermal Calculations

Using the architectural, structural, mechanical and electrical plans and specification, the designer can determine manually or with the aid of a computer program the total estimated maximum heating and cooling loads[1] for each building in the site. Because the TU plant is located on a military reservation weather data used in the load calculation must be extracted from "The Department of the Army Technical Manual TM5-785 AFM 88-8 Chapter 6. Fig. 2 is the resultant thermal load calculations summarized by building and including the existing electrical loads and the surveyed population counts.

Computer Study

Because of the coincidental and summary loads on the site which the plant must serve, the design should employ a recognized energy system program to develop the data for thermal profiles and for the selection of the major thermal equipment. The manually calculated data must be reorganized in a manner as shown on Fig. 3 "Computer Loading and Summarized Data" inorder to be fed into the computer.

The Ross F. Meriwether Energy System Series Program was selected for the Ft. Belvoir study running only the following sections:

a. ERE Energy Requirement Estimate

b. ERD Energy Requirement Estimate Read out

c. TCR Total Coincident Requirement

This task required only the above (3) series since it was not required to determine the total energy consumption or to match various combinations of generating and thermal equipment. The (ERE) phase of the program produces the thermal and electrical demands for each building in the complex every hour of the year while the ERD phase reads this data for certain selected days on a 24 hour basis. The output from this phase of the program is then used to prepare the family of profiles such as heating, cooling and domestic hot water. All of the buildings are summarized coincidently under the TCR section of the program. This information allows us to make equipment selections and determine the maximum recoverable energy. Fig. 4a, b,c and d, Fig. 5a and b; and Fig. 6a, b, c and d are the heating, cooling and domestic hot water profiles for the Ft. Belvoir site. You will note that the curves cover a 3 day period representing weekdays and weekends.

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[1] ASHRAE Guide Chapter 30, 1970.

The total loads for all buildings combined Fig. 7 also results from the TCR section of the program and delineates the total monthly heating, cooling, domestic hot water and electrical loads during the year. For each kilowatt hour generated 4000 BTU can be recovered and reused; thus if we deride the recovered heat to the total heat required the produce equals the possible energy saved. This can be directly converted into fuel input. Fig. 8 indicates a family of curves describing the energy required, the energy recovered and the percentage of fuel saved. Algebracially these curves describe all comparable sites except for the numerical values will vary with geographic location and military usage. At this point into the study, the designer can reach a milestone decision. Does the possible energy savings warrant finishing the preliminary design inorder to price out the construction of this TU plant? In the case of Ft. Belvoir, Va., the possible fuel savings of (48% or 40%) maximum to (24% to 19%) minimum with or without incinerator assists, justifies that the design proceed to its final conclusion.

Equipment Selection

The engine-generators serve a dual purpose in the total utility system: (1) provide for the electrical energy to the site and plant; (2) provide for a major portion of the recoverable energy. By extracting heat from the exhaust, the engine jacket and the lubricating oil coolers approximately 4000 BTU can be recovered for every kilowatt hour generated. Primarily the generators should satisfy the peak electrical load which reaches 1157 KW on August 19 & 20 at 12 o'clock noon Fig. 1c. The equipment load was therefore established at approximately 1200 KW. Considering the importance of reliability and redundancy in the TU plant, the designer therefore selected four (4) diesel driven engine-generators each rated at 600 KW producing 480 KW each or 1440 KW total on the line with one (1) engine-generator in reserve. The selection of the 600 KW unit was based upon manufacture sizes available.

The maximum heating required by the site was established by adding the peak heating load on January 23 (15717 MBTU/HR) Fig. 5a and the peak domestic hot water load (3517 MBTU/HR) Fig. 4c. Fig. 1a shows that the maximum electrical demand on January 23 was approximately 904 KW which would result in a possible recovery of 3,608 MBTU/HR. With this recovery credited to the total site requirement, the net site requirement is reduced to approximately (15,616 MBTU/HR). Four hot water boilers at 5200 MBTU/HR output each were selected for the plant; three on the line with one boiler in reserve. See Fig. 10 showing the plant equipment selection and thermal balance.

The effect of heat recovery from incineration did not enter into the selection of boilers since the burning was assumed on a 7 hour 5 day week operation and would not be available 24 hours a day. During the incineration process (1) one boiler can drop off the line.

Refering to the calculated building load summaries, the estimated cooling load on the site was approximately 970 tons. This information was input into the computer program resulting in chart Fig. 9 Count of Hours at 10% Increments of Assumed Peak Loads. This chart indicated that cooling would be needed up to only 70% of the assumed peak load and that 52% of the cooling hours would operate at and under 10% of the assumed peak load. This information is significant because it allows the designer to select the base refrigeration machine and the absorption machine. The designer selected a 118 ton electric centrifugal machine because over 50% of the operating hours were in this range and the total electrical input load did not increase the size of the generating units. The total refrigeration plant should be sized for approximately .70 x 970 = 680 tons plus parastic load Fig. 9. Adding the plant parastic load and subtracting the base machine load, the designer selected an absorption unit capable of producing 620 tons. During the summer months, only two (2) boilers will be needed to produce the required heating energy (see Fig. 10) and can be reduced when the incinerator is in operation.

Solid Waste System

The incinerator with heat recovery design should parallel the generating portion of the (T.U.) plant. The engineers must survey the solid waste generated in each of the sixteen buildings on the site as to quantity by weight, type, heat content, and density (see chapter V). The incinerator recoverables can then be matched and interfaced through a heat exchanger or thermal storage tank to increase the fuel savings to the total system. The designer recommended a 7 hour burn with the data tabulated in chapter V.

The selection of the incinerator should be based upon the type of wastes incinerated, the cost to operate and maintain and the compliance with present emission standards. We selected a two chamber controlled air type of incinerator for the Ft. Belvoir project.

The size of the building housing the waste disposal system is based upon the size of the incinerator and loader selected, also the garbage storage and the operating area around the incinerator.

Heat may be recovered in several ways. Using an integrated gas to water heat exchanger with the incinerator we can generate 220°F water or 420°F for use in the heat producing plant or the sludge drying exchanger. If the above method does not apply the flue gases from the incinerator may be directly introduced to the hot water boilers.

Flow Diagrams

Once the major equipment has been determined, the designer should proceed to prepare block or flow diagrams for the thermal systems such as hot water, chilled and condenser water, fuel oil and oil cooler flow and lubricating oil and compressed air flow diagrams. These diagrams are represented on sheets SKM-8, SKM-9, SKM-10 and SKM-12 and indicate primary secondary hot water systems as a means of energy transfer in the plant.

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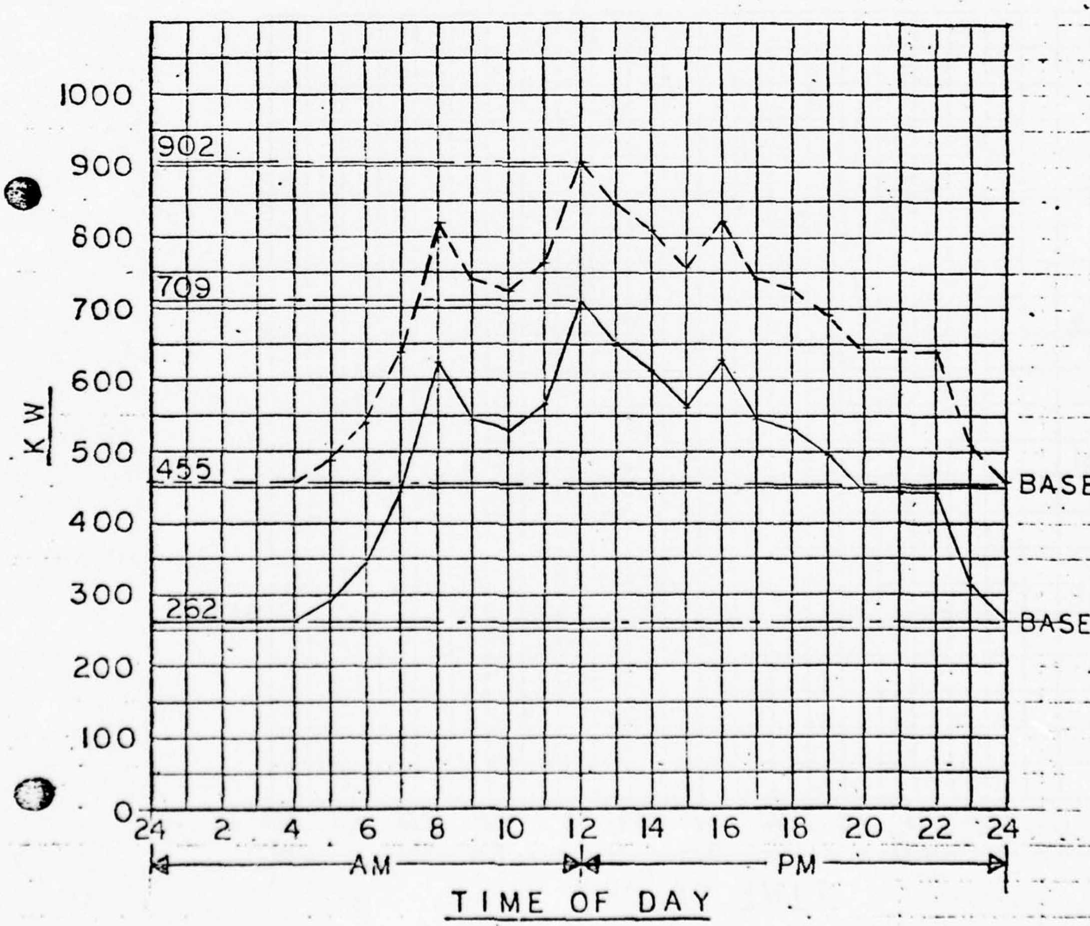
Comp. By AM Date 7-15-76 Sheet ____ of FIG 1a
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND
For ELECTRICAL PROFILE COMPOSITE BUILDINGS NO I THRU 16
JANUARY 22 & 23

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO I THRU 16

– – – – TOTAL KW LOAD BUILDINGS NO I THRU 16
TUS PLANT AND SEWAGE TREATMENT



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CHICAGO, ILLINOIS 60606

FIG 1b

Comp. By AM Date 7-15-76 Sheet ____ of ____

Chkd. By ____ Date ____ Job No. 4430

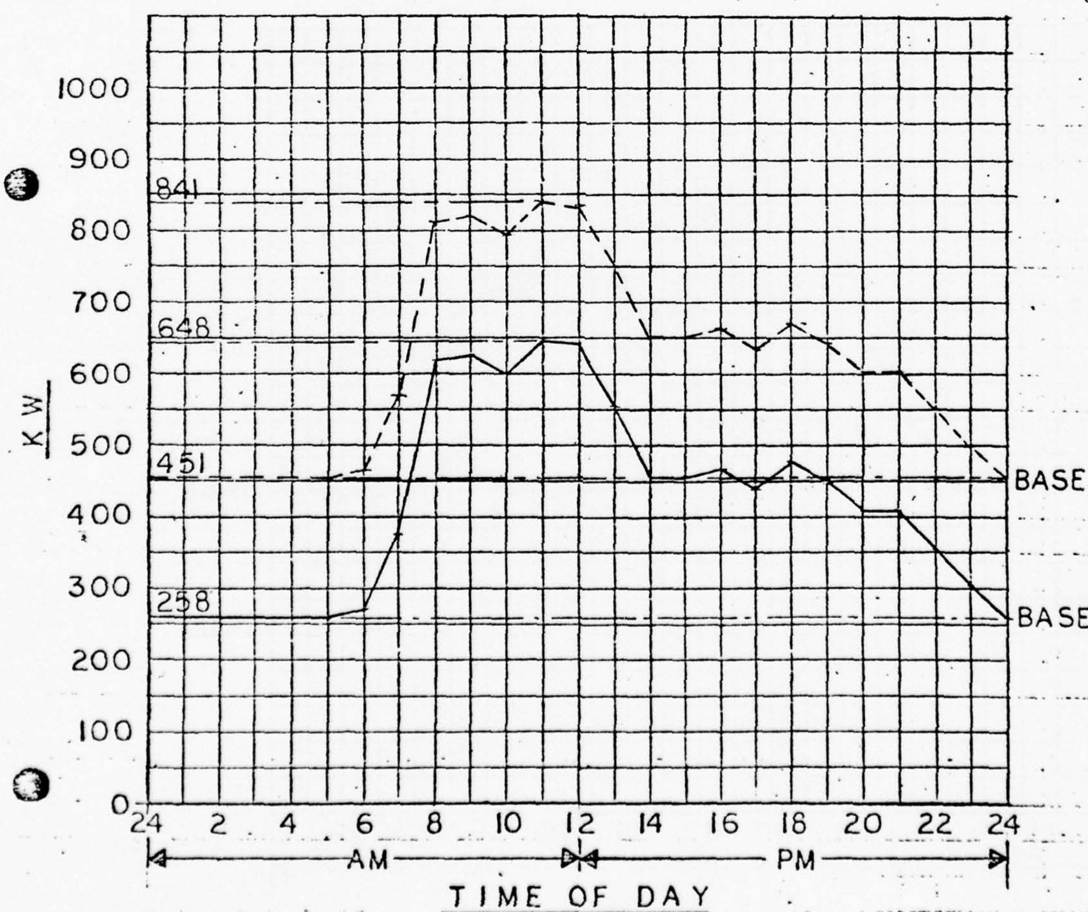
Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO 1 THRU 16

For ELECTRICAL PROFILE COMPOSITE JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO 1 THRU 16

– – – – TOTAL KW LOAD BUILDINGS NO 1 THRU 16 TUS PLANT AND SEWAGE TREATMENT



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CHICAGO, ILLINOIS 60606

FIG 1c

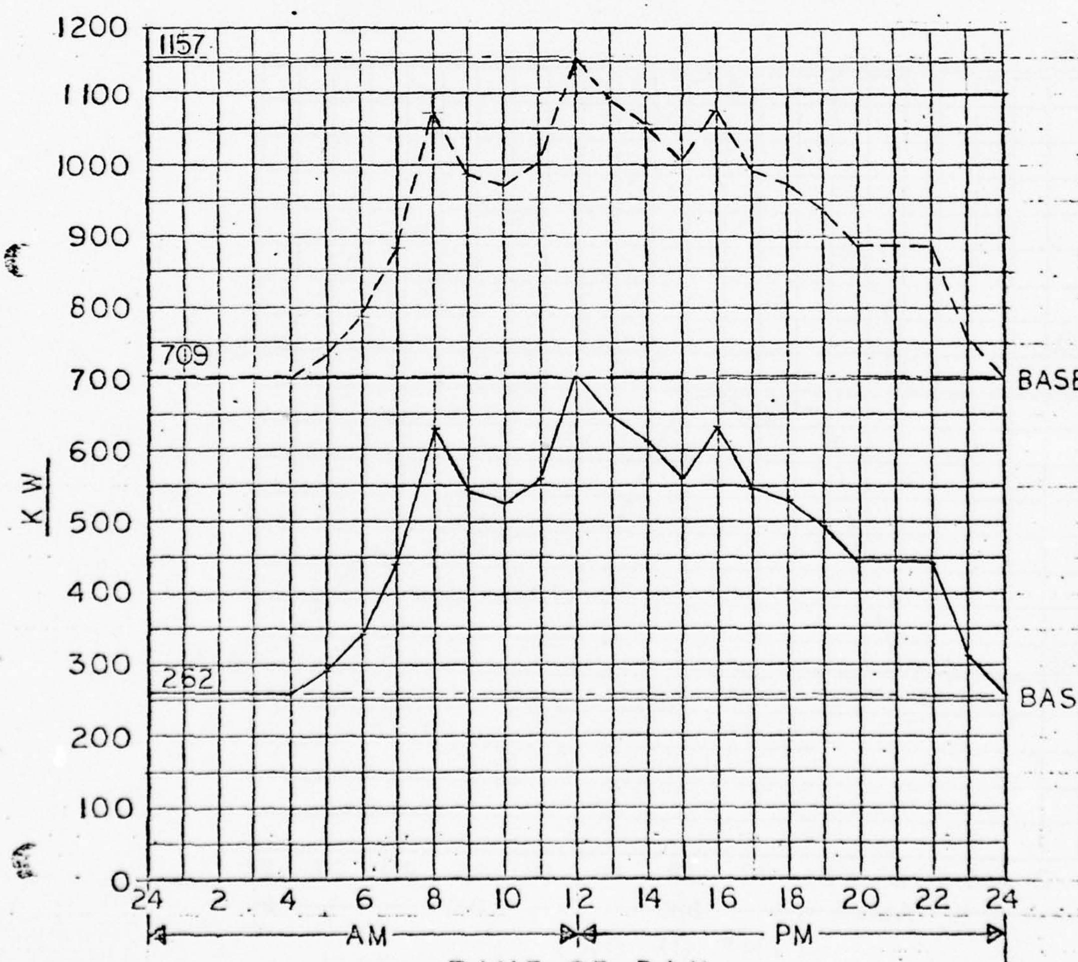
Comp. By AM Date 7-15-76 Sheet ___ of ___
Chkd. By ___ Date ___ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND
For ELECTRICAL PROFILE COMPOSITE BUILDINGS NO I THRU 16
AUGUST 19 & 20

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO I THRU 16

- - - - TOTAL KW LOAD BUILDINGS NO I THRU 16
TUS PLANT AND SEWAGE TREATMENT



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CHICAGO, ILLINOIS 60606

FIG 1d

Comp. By AM Date 7-15-76 Sheet ____ of ____
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO I THRU 16
For ELECTRICAL PROFILE COMPOSITE
AUGUST 21

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL KW LOAD - BUILDINGS NO I THRU 16
- - - - TOTAL KW LOAD BUILDINGS NO I THRU 16 TUS PLANT AND SEWAGE TREATMENT

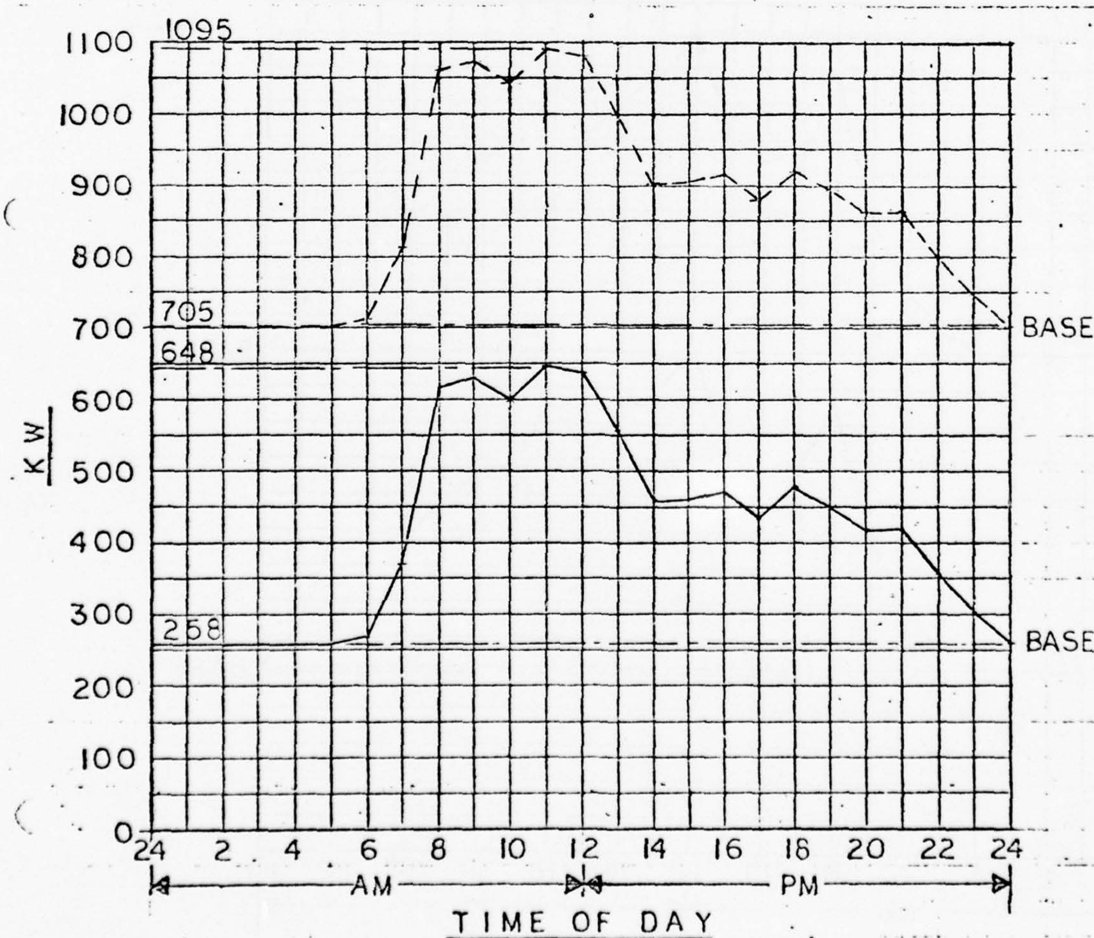


FIG 2

Prepared by DP 5/7/76
REV AM 5/21/76
REV B.D. 6/1/76

—MIUS FORT BELVOIR, VA. #4430
BUILDING LOAD SUMMARY DATA

BUILDING DESIGNATION NUMBER	DESCRIPTION + TYPE OF BUILDING	FLOOR AREA SQ. FT.	TOTAL BUILDING VOLUME	HEATING LOAD DATA: TRANS. LOAD	HEATING LOAD DATA: INFILT. LOAD	HEATING LOAD DATA: OUTSIDE AIR LOAD	COOLING LOAD DATA: TRANS. + SOLAR	COOLING LOAD DATA: INFILT. LOAD	COOLING LOAD DATA: OUTSIDE AIR LOAD	PEOPLE LOAD: SENSIBLE	PEOPLE LOAD: LATENT	LIGHTS: KW PER ft²	ELECTRICAL LOADS: LIGHTING KW	ELECTRICAL LOADS: POWER KW	EXIST. HEATING COIL CAP. LOADS	EXIST. COOLING COIL CAP. LOADS	EXIST. DOMESTIC HOT WATER LOADS
1	EM BARRACKS BUILDING (3) MODULES (BCD) (BCD) (ACD)	32220	257760	718720	198350	269610	587275	179625	244515	34300	28700		18.0	15.5	1248250	1072885	450000
2	EM BARRACKS BUILDING (3) MODULES (BCD) (BCD) (ACD)	32220	257760	718720	198350	269610	587275	179625	244515	34300	28700		18.0	15.5	1248250	1072885	450000
3	EM BARRACKS BUILDING (3) MODULES (BCD) (ACD) (BCD)	32220	257760	720468	198350	269610	588480	179625	244220	34300	28700		18.0	15.5	1248250	1072895	450000
4	EM BARRACKS BUILDING (3) MODULES (BCD) (ACD) (BCD)	32220	257760	720350	198350	269610	593940	179625	244220	34300	28700		18.0	15.5	1248250	1072895	450000
5	EM BARRACKS BUILDING (4) MODULES (ACD) (BCD) (BCD) (ACD)	42960	343680	962665	264464	361950	791355	239500	328460	45080	37720		23.8	22.0	1662500	1423090	700000
6	EM BARRACKS BUILDING (2) MODULES (BCD) (ACD)	21480	171840	478469	132232	180975	369450	119750	163930	22540	18860		12.0	11.0	831250	711545	450000
7	DISPENSARY GROUP BUILDING	3195		88377	21425	31400	79845	19405	28440	2450	2050		6.70	31.0	250000	128740	30690 9.0 kw
8	BRANCH EXCHANGE BUILDING	4720		122400	21425	163800	87750	19405	133365	12250	10250		14.875	23.5	423000	479000	30690 9.0 kw
9	3 COMPANY ADMIN. #1 (OFF.)	5402		104270	33427	36936	81480	30277	33455	11025	9225		15.45	2.23	129000	180000	40920
	(STOR.)	8640		136565	99110	0	0	0	0	0	0		9.10	4.80	360000	NONE	12 kw
10	3 COMPANY ADMIN. #2 (OFF.)	5402		104270	33427	36936	132690	30277	33455	11025	9225		15.45	2.23	129000	180000	40920
	(STOR.)	8640		136565	91110	0	0	0	0	0	0		9.10	4.80	360000	NONE	12 kw
11	4 COMPANY ADMIN. (OFF.)	6910	87439	134310	14260	49248	105000	40090	44610	14700	12300		20.60	2.98	172000	240000	59560
	(STOR.)	11640		173175	133710	0	0	0	0	0	0		12.10	5.35	480000	NONE	16 kw
12	SECOND BATTALION HQ AND CLASSROOM BLDG	11989	170864	264600	96095	160670	197290	87026	142715	21840	10680		25.50	17.1	1120000	835700	26,000 7.5 kw
13	HEADQUARTERS BUILDING REGIMENTAL/BRIGADE	9843	98430	157720	62730	47710	101310	55770	42380	11025	6975		15.30	10.70	526408	216898	13660 4.0 kw
14	FOOD SERVICE FACILITY BUILDING	15172	151720	289120	116717	2266950	183620	105720	929600	93500	93500		34.25 9.00	34.5 60.6	3005300	2352000	1040000
15	UNIT CHAPEL BUILDING	8684	165606	211030	100530	184680	164720	91045	167280	6930	32340		7.70	10.5	444110	332510	13660 4.0 kw
16	GYMNASIUM BUILDING (NO COOLING SYSTEM)	20781	484384	471670	362577	1606716	0	0	0	0	0		51.80	39.81	2529000	(ak 12000)	690000
		284701		6715464	2082710	6206411	4,651,480	1556765	3025160	451935	357725		264.1250	345.10	17414568	11521243	4680000

less kw load (hw only)

FIG 3

TM 5/13/76
Rev RM 5/24/76
Rev 6/1/76

MIUS FORT BELVOIR, VA #4430
COMPUTER LOADING AND
SUMMARY TAKE-OFF DATA

BUILDING DESIGNATION AND TYPE	TOTAL WALL AREA				TOTAL GLASS AREA				TOTAL INSUL. PNL. AREA				TOTAL LIGHTS KW	TOTAL FCU		TOTAL MISC MOTORS KW	NO. OF PEOPLE	TOTAL SOLAR LOAD					SOLAR LOAD % GLASS					TOTAL HEATING	TOTAL SENS COOLING	TOTAL LAT. COOLING	TOTAL COOLING	ROOF AREA
	NW	NE	SW	SE	NW	NE	SW	SE	NW	NE	SW	SE		NO	WATTS			ROOF	NW GLASS	NE GLASS	SW GLASS	SE GLASS	NW	NE	SW	SE	ROOF					
1 EM BARRACKS BUILDING (3) MODULES (BCD)(BCD)(ACD)	5286	3672	3672	5286	635	1998	1998	947	317	759	891	346	18.0	89	1428	15.5	140	79047	25410	63936	213543	32198	6	15	52	8	19	988330	748312	192806	941118	10740
2 EM BARRACKS BUILDING (3) MODULES (ACD)(BCD)(ACD)	5286	3672	3672	5286	635	1998	1998	947	317	759	891	346	18.0	89	1428	15.5	140	79047	25410	63936	213543	32198	6	15	52	8	19	988330	748312	192806	941118	10740
3 EM BARRACKS BUILDING (3) MODULES (BCD)(ACD)(BCD)	5286	3672	3672	5286	739	1998	1998	803	346	891	891	337	18.0	89	1428	15.5	140	79047	29572	63936	213543	28674	7	15	52	7	19	970080	751637	192512	944149	10740
4 EM BARRACKS BUILDING (3) MODULES (BCD)(ACD)(BCD)	5286	3672	3672	5286	635	1998	1998	947	317	891	891	346	18.0	89	1428	15.5	140	79047	25400	63936	213543	32198	7	15	52	7	19	989760	756975	192512	949487	10740
5 EM BARRACKS BUILDING (4) MODULES (ACD)(ACD)(BCD)(BCD)	6797	4896	4896	6797	1224	2664	2664	1017	442	1188	1188	424	23.8	118	1971	22.0	184	105395	47828	85248	284124	34564	9	15	51	6	19	1324615	1016449	258228	1274677	14320
6 EM BARRACKS BUILDING (2) MODULES (BCD)(ACD)	3022	2448	2448	3524	612	1332	1332	508	221	594	594	212	12.0	59	745	11.0	92	52984	24410	42624	142362	17306	9	15	51	6	19	659445	482004	128916	610920	7160
7 DISPENSARY GROUP BUILDING	282	662	642	313	84	114	166	43	35	–	–	–	4.70	0	0	31.0	10	23643	3362	3648	31042	1462	5	6	49	2	38	119780	118221	21529	139745	3195
8 BRANCH EXCHANGE BUILDING	710	400	610	640	220	0	60	300	0	0	0	0	14.875	0	0	23.5	50	34928	8800	0	11220	10700	14	0	17	16	53	286191	205995	96774	302769	4720
9 3 COMPANY ADMIN. (OFF.) BUILDING #1 (STOR.)	533	1949	1256	533	0	0	252	0	0	0	220	0	15.45 9.10	0	0	2.23 4.10	45	39975	0	0	0	11764	0	0	0	23	77	141206 235675	163530 NONE	33465 NONE	196995 NONE	5400 8640
10 3 COMPANY ADMIN. (OFF) BUILDING #2 (STOR)	1949	533	533	1256	0	0	0	252	0	0	0	220	15.45 9.10	0	0	2.23 4.10	45	39975	0	0	64702	0	0	0	61	0	39	141206 235675	214739 NONE	33465 NONE	248204 NONE	5400 8640
11 4 COMPANY ADMIN (OFF) BUILDING (STOR)	1674	533	533	2592	336	0	0	0	274	0	0	0	20.60 10.30	0	0	2.98 5.50	60	51150	18490	0	0	0	21	0	0	0	73	183560 306885	214400 NONE	44620 NONE	259020 NONE	6910 11640
12 TWO BATTALION HDQTRS & CLASSROOM BUILDING	1256	1804	2024	1255	201	510	290	201	0	0	0	0	25.50	0	0	1.32 121	96	82724	8040	16380	27438	6274	6	11	19	5	53	427270	366629	108295	474924	11949
13 HEADQUARTERS BLDG REGIMENTAL/BRIGADE	2060	720	720	1600	236	96	96	402	104	52	52	72	15.30	23	45	2.5 10.7	45	23552	9440	3072	17953	13670	14	5	21	20	34	220450	178405	35960	214365	3200
14 FOOD SERVICE FACILITY BUILDING *	1443 965S	1500 0S	1155 1257S	1443 965S	230 230S	298 0S	666 666S	230 230S	0	0	0	0	34.85 (9.00)	0	0	0.584 39.5 (60.6)	340	53406	9200	0	75591	7820	6	0	52	5	37	2556070	868503	729300	1597803	15122/ 9675 C
15 UNIT CHAPEL BUILDING	1410	1744	1859	1223	361	442	332	128	0	0	0	0	7.70	18	131	1.55 10.5	308	39946	12895	11315	49670	3410	11	10	42	3	34	395710	329767	144540	474377	8649
16 GYMNASIUM BUILDING (NO COOLING SYSTEM)	4450	3627	3554	4652	110	57	110	161	0	0	0	0	51.80	0	0	0 39.81	0						2	1	10	3	84	2078365				21357
																												13268025	7163872	2405723	9242440	179391

353.425 TOTAL
(264.175 TOTAL KW COOLING ONLY)
= 244.74 KW COOLING ONLY
= 835,787 BTU/HR OR 69.65 TONS

* S = COOLED AREA ONLY

7163872
2405723
9569595
-327157 KW DEDUCTION
9242438 BTU/HR TOTAL
12000
= 770.20 TONS
-840 TONS STOR. FACTOR
696.20
-125.00 CHANGE IN DA QUANTITY
= 571.0 TONS

SF = 180,000 ft³ × 1.4 × 4°F
= 1008,000 BTU/HR
12000/TON
= -84.0 TONS

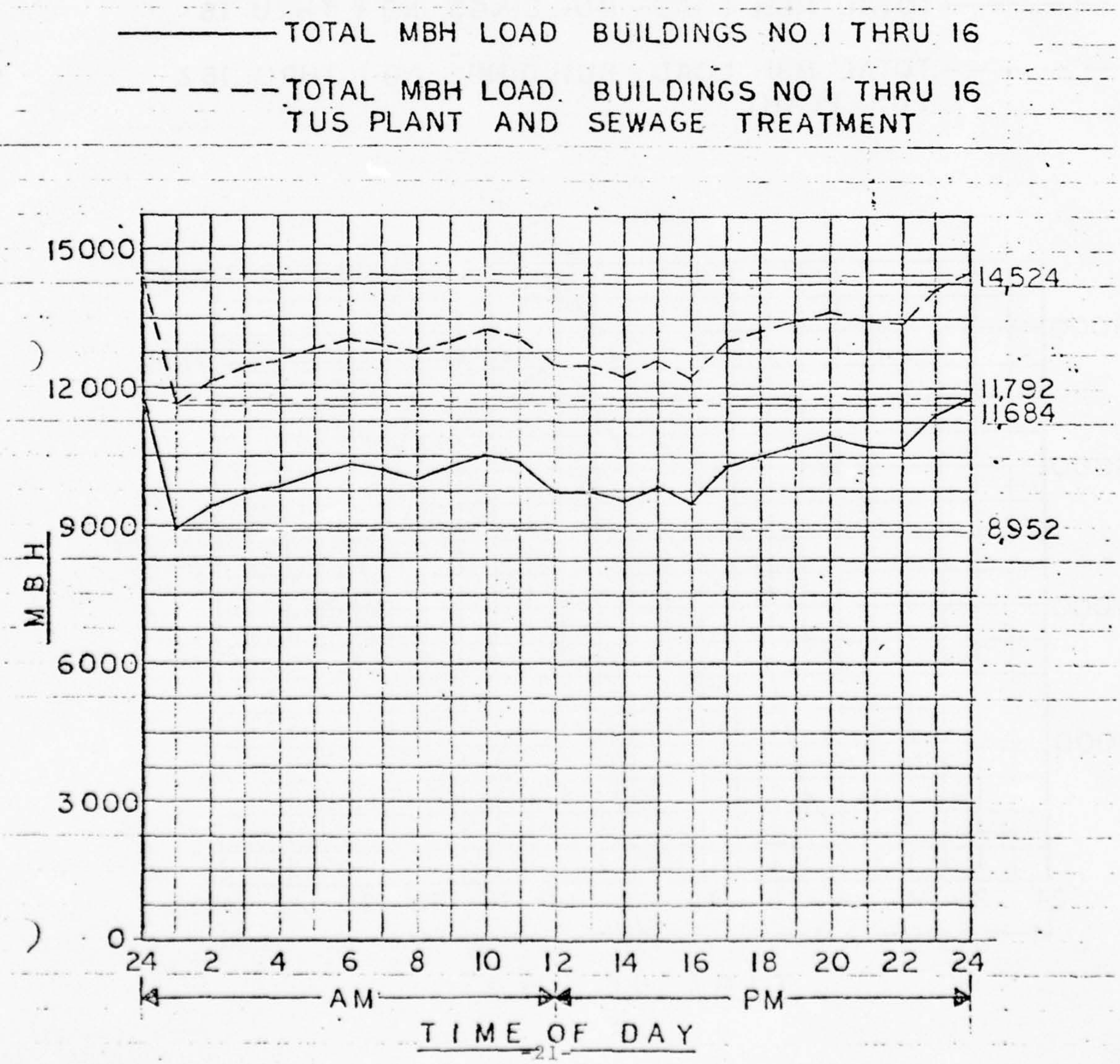
GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 4a

Comp. By AM Date 7-15-76 Sheet ____ of ____
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND
For HEATING PROFILE COMPOSITE BUILDINGS NO 1 THRU 16
JANUARY 22

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



Comp. By A M Date 7-16-76

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 4b

Sheet ______ of ______

Chkd. By ______ Date ______

Job No. 4430

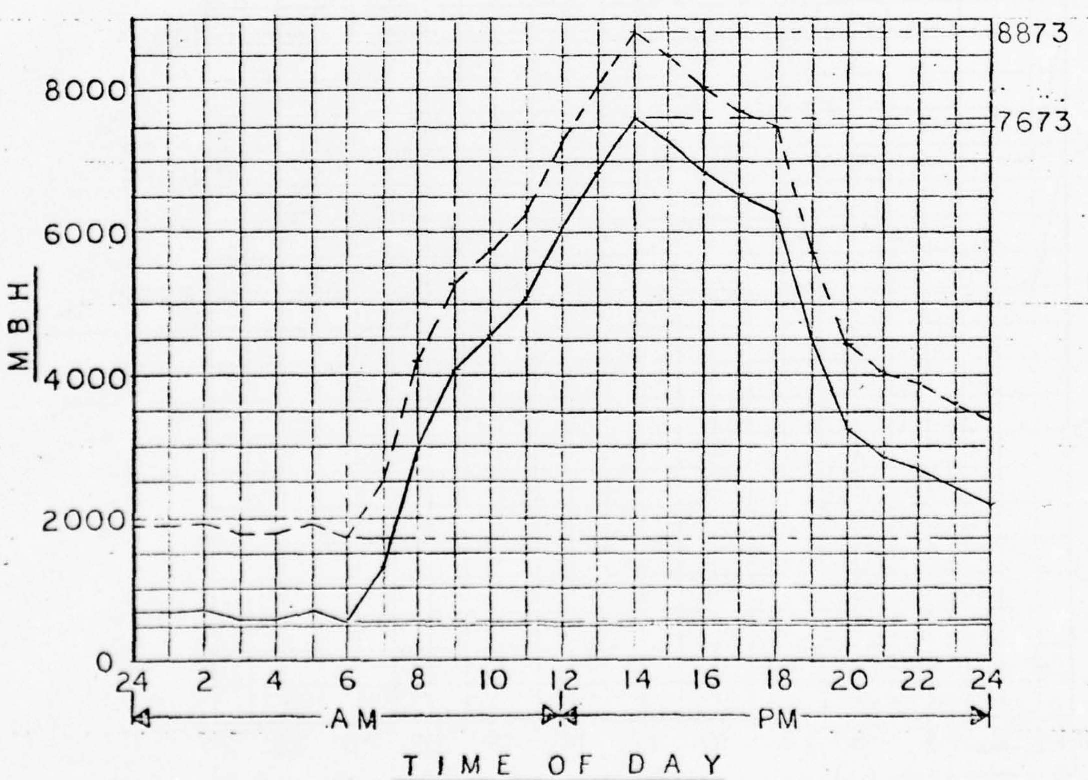
Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO I THRU 16

For COOLING PROFILE COMPOSITE AUGUST 19

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——————TOTAL MBH LOAD - BUILDINGS NO I THRU 16

– – – – – –TOTAL MBH LOAD - BUILDINGS NO I THRU 16 & TUS PLANT



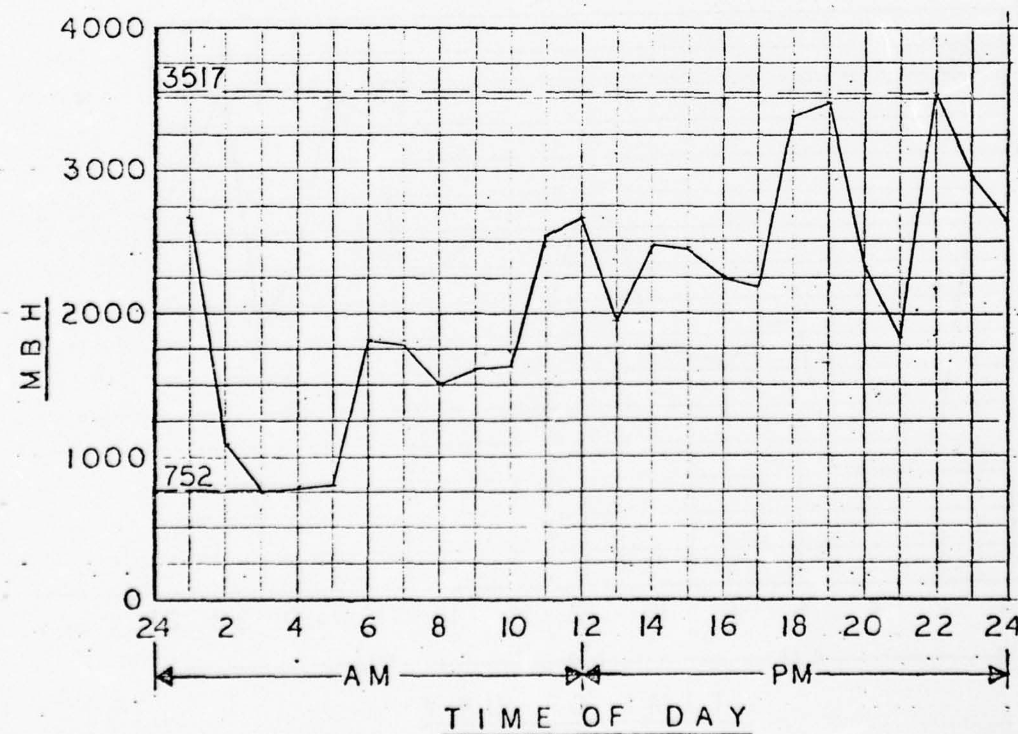
GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 4c

Comp. By A M Date 7-20-76
Chkd. By ______ Date ______
Sheet ____ of ____
Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONLY
For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE
JANUARY 22 & 23

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



Comp. By AM Date 7-20-76

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 4d
Sheet ____ of ____

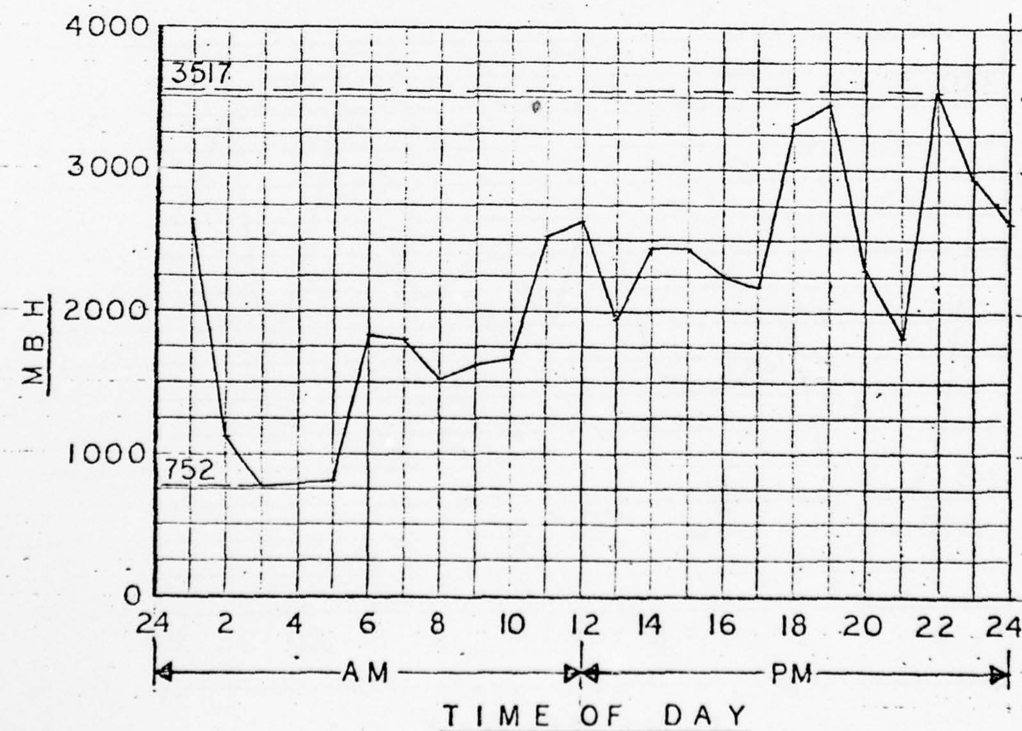
Chkd. By ____ Date ____

Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONLY

For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE AUGUST 19 & 20

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 5a

Comp. By AM Date 7-15-76 Sheet ____ of ____

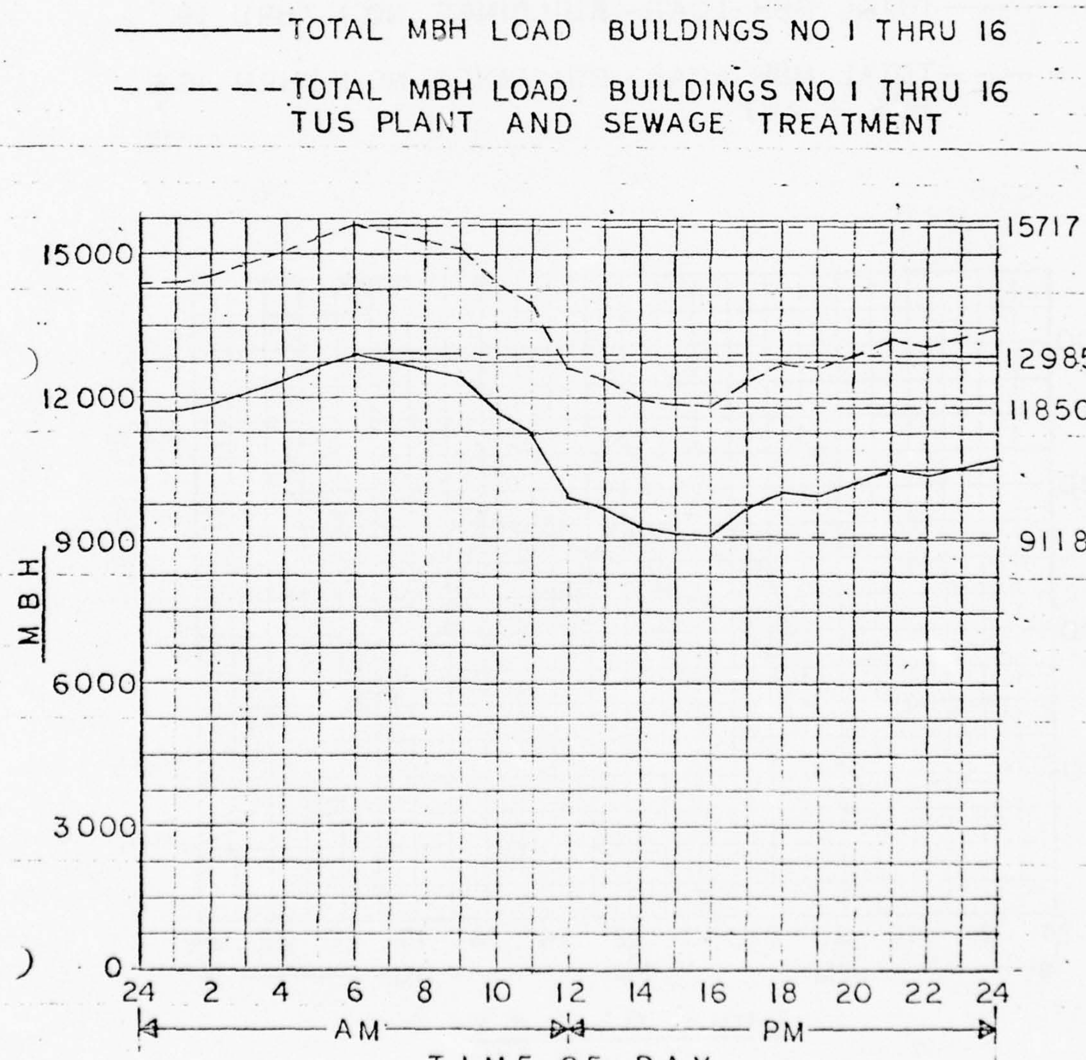
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND

For HEATING PROFILE COMPOSITE BUILDINGS NO I THRU 16

JANUARY 23

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

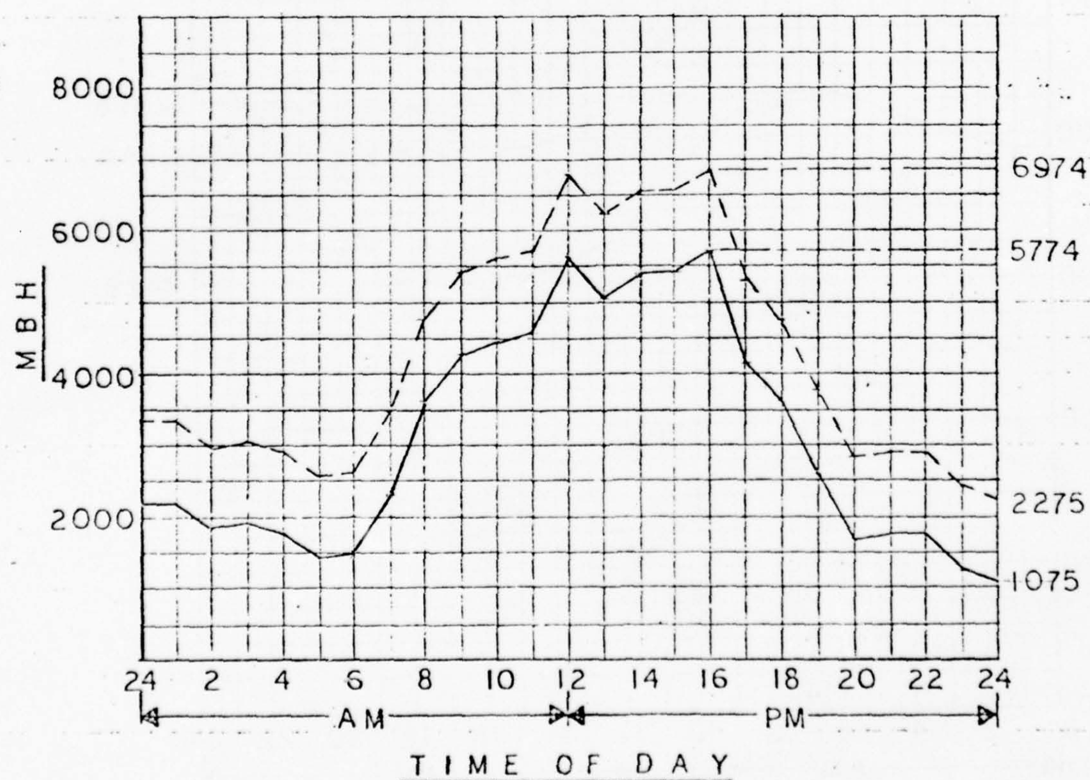
Comp. By A M Date 7 16 76 | Sheet ____ of ____ FIG 5b
Chkd. By ____ Date ____ | Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO I THRU 16
For COOLING PROFILE COMPOSITE
AUGUST 20

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL MBH LOAD - BUILDINGS NO I THRU 16

– – – – TOTAL MBH LOAD - BUILDINGS NO I THRU 16 & TUS PLANT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 6a

Comp. By AM Date 7-16-76 Sheet ____ of ____

Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND

For HEATING PROFILE COMPOSITE BUILDINGS NO 1 THRU 16

JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL MBH LOAD BUILDINGS NO 1 THRU 16

– – – – TOTAL MBH LOAD. BUILDINGS NO 1 THRU 16 TUS PLANT AND SEWAGE TREATMENT

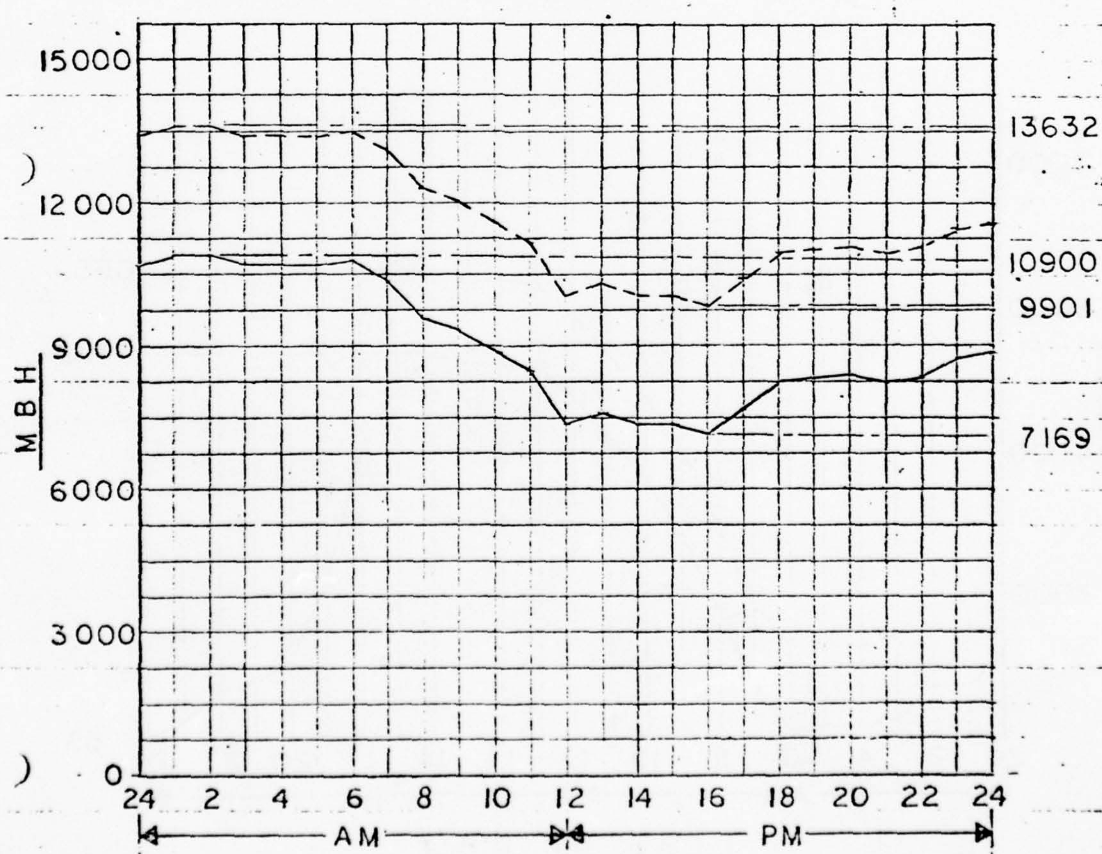


FIG 6b

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
209 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By AM Date 7-16-76 Sheet ____ of ____

Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO 1 THRU 16

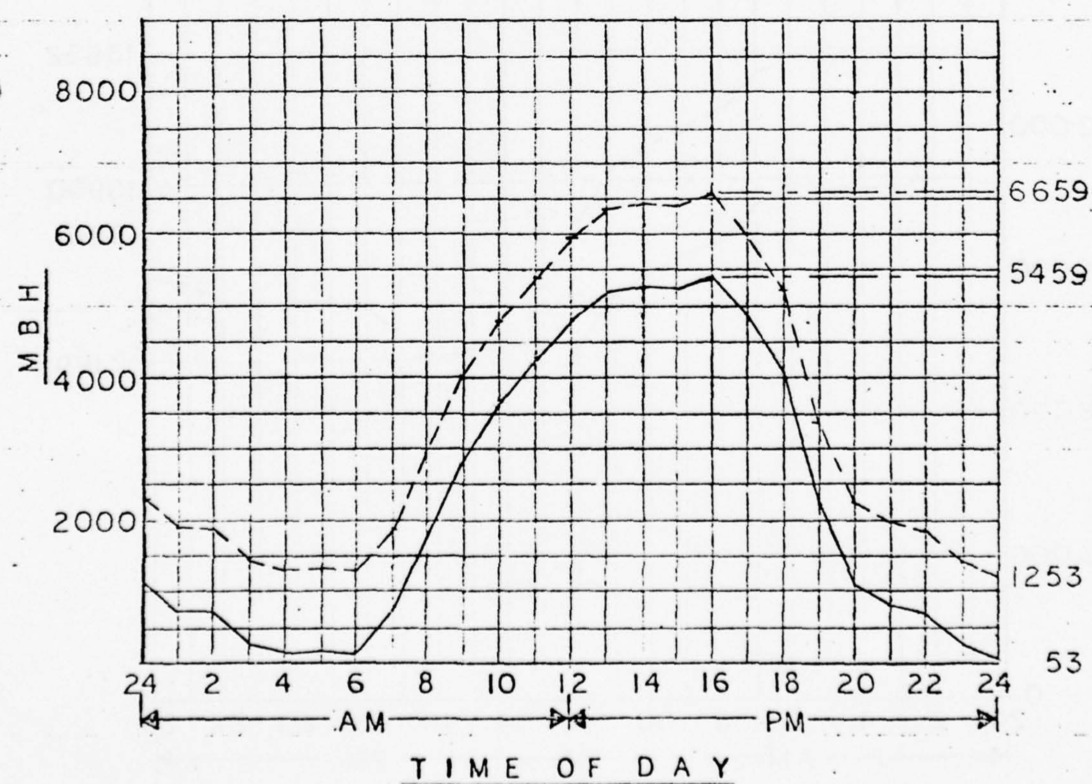
For COOLING PROFILE COMPOSITE

AUGUST 21

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16

– – – – TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16 & TUS PLANT



GARIZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
203 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

FIG 6c

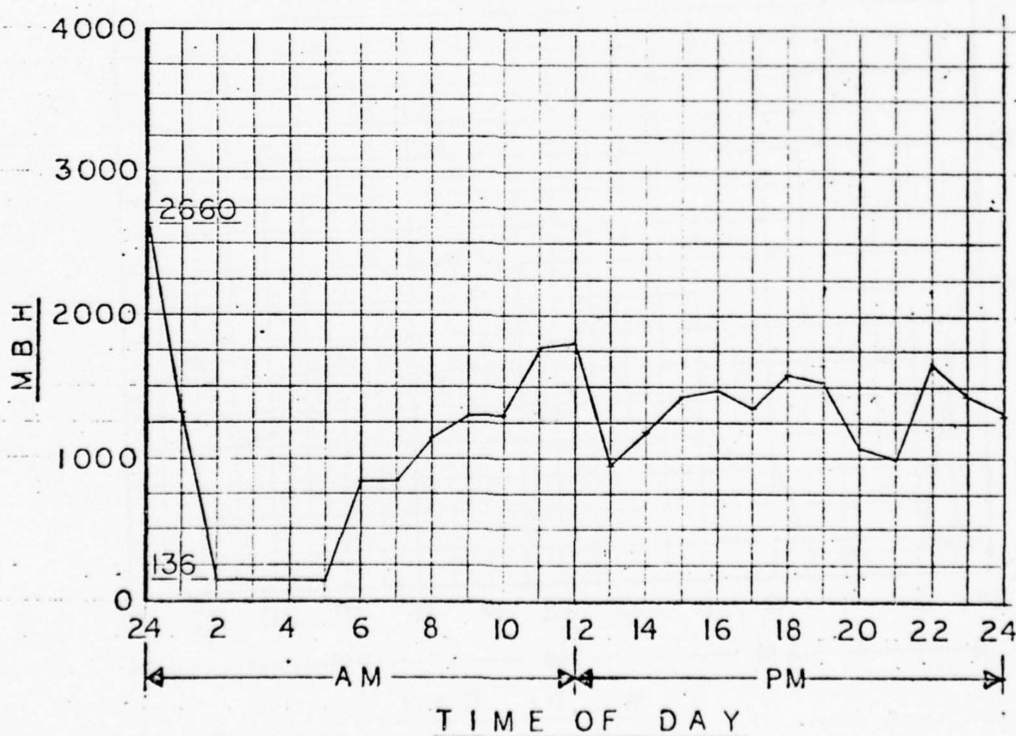
Comp. By A M Date 7-20-76 Sheet ____ of ____

Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONL

For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



Comp. By A M Date 7-20-76	GAMZE-KOROBKIN-CALOGER CONSULTING ENGINEERS 205 WEST WACKER DRIVE CHICAGO, ILLINOIS 60606	FIG 6d	
		Sheet ____ of ____	
Chkd. By ____ Date ____		Job No. 4430	

Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONLY

For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE

AUGUST 21

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

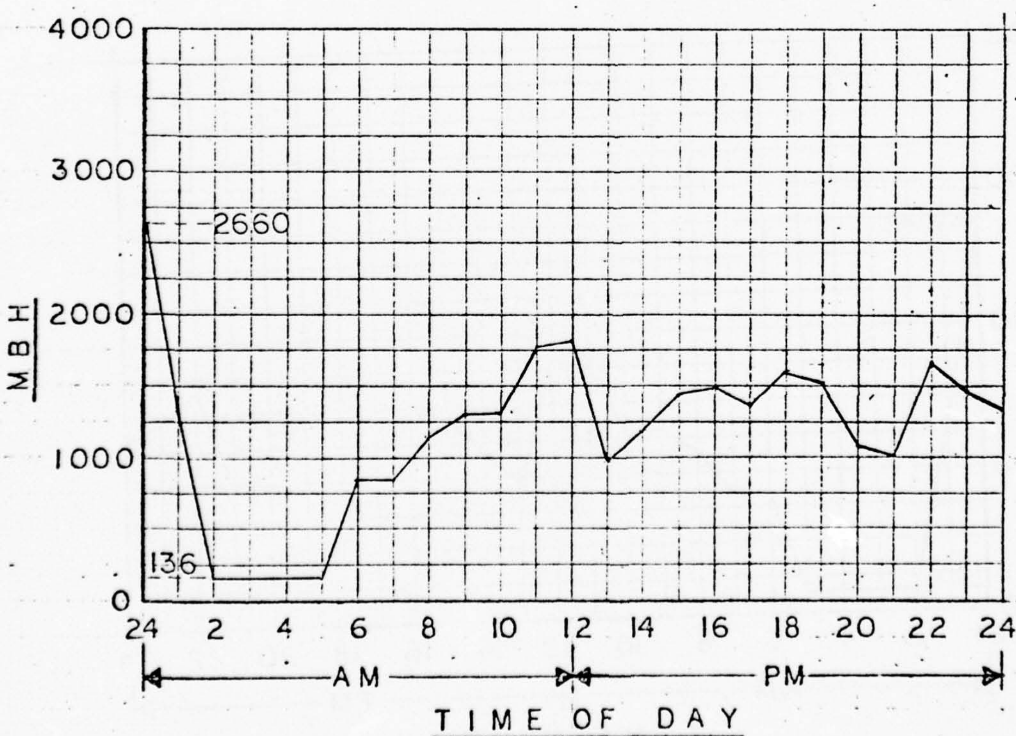


FIG 7

TOTAL COINCIDENT REQUIREMENT FOR FT BELVOIR, TCR007 AND OOH ****TOTAL SITE****

TOTAL LOADS FOR ALL BUILDINGS COMBINED

	HEATING MBTU	HEATING HOURS	COOLING TON-HRS	COOLING HOURS	IND PROC MBTU	DIR PROC MBTU	ELECTRIC KWH	AUX FUEL HOURS
JAN	5655733.	738	1999.	37	1338130.	25456.	333668.	0
FEB	4687809.	669	1464.	35	1185503.	22264.	300440.	0
MAR	4127451.	716	8586.	121	1362030.	26209.	334638.	0
APR	2372476.	606	27793.	357	1335056.	25898.	324531.	0
MAY	901557.	292	88285.	640	1314228.	24703.	332699.	0
JUN	290607.	114	118895.	713	1335056.	25898.	324531.	0
JUL	11090.	8	146628.	744	1385931.	26962.	335607.	0
AUG	77945.	37	130566.	744	1338129.	25456.	333668.	0
SEP	744357.	276	92106.	668	1335056.	25898.	324531.	0
OCT	2127677.	572	33613.	452	1362031.	26209.	334638.	0
NOV	3713556.	671	14232.	163	1287254.	24392.	322592.	0
DEC	5441643.	744	502.	22	1362030.	26209.	334638.	0
ANN	30152100.	5443	664668.	4696	15940435.	305558.	3936179.	0

UNIT VALUES OF BUILDING ENERGY PEAKS AND CONSUMPTION

HEATING PEAK	41.57	BTUH/SQFT
HEATING CONSUMPTION	96.53	MBTU/SQFT
FULL LOAD HEATING	2322.	HRS
COOLING PEAK	2.07	TONS/1000 SQFT
OR	483.33	SQFT/TON
COOLING CONSUMPTION	2.13	TON-HRS/SQFT
FULL LOAD COOLING	1029.	HRS
PROCESS PEAK	11.71	BTUH/SQFT
PROCESS CONSUMPTION	52.01	MBTU/SQFT
INDIRECT	51.03	MBTU/SQFT
DIRECT	.98	MBTU/SQFT
FULL LOAD PROCESS	4442.	HRS

GAMZE-KOROBKIN-CALOGER

CONSULTING ENGINEERS

303 WEST WACKER DRIVE

CHICAGO, ILLINOIS 60606

FIG 3

Comp. By________ Date________

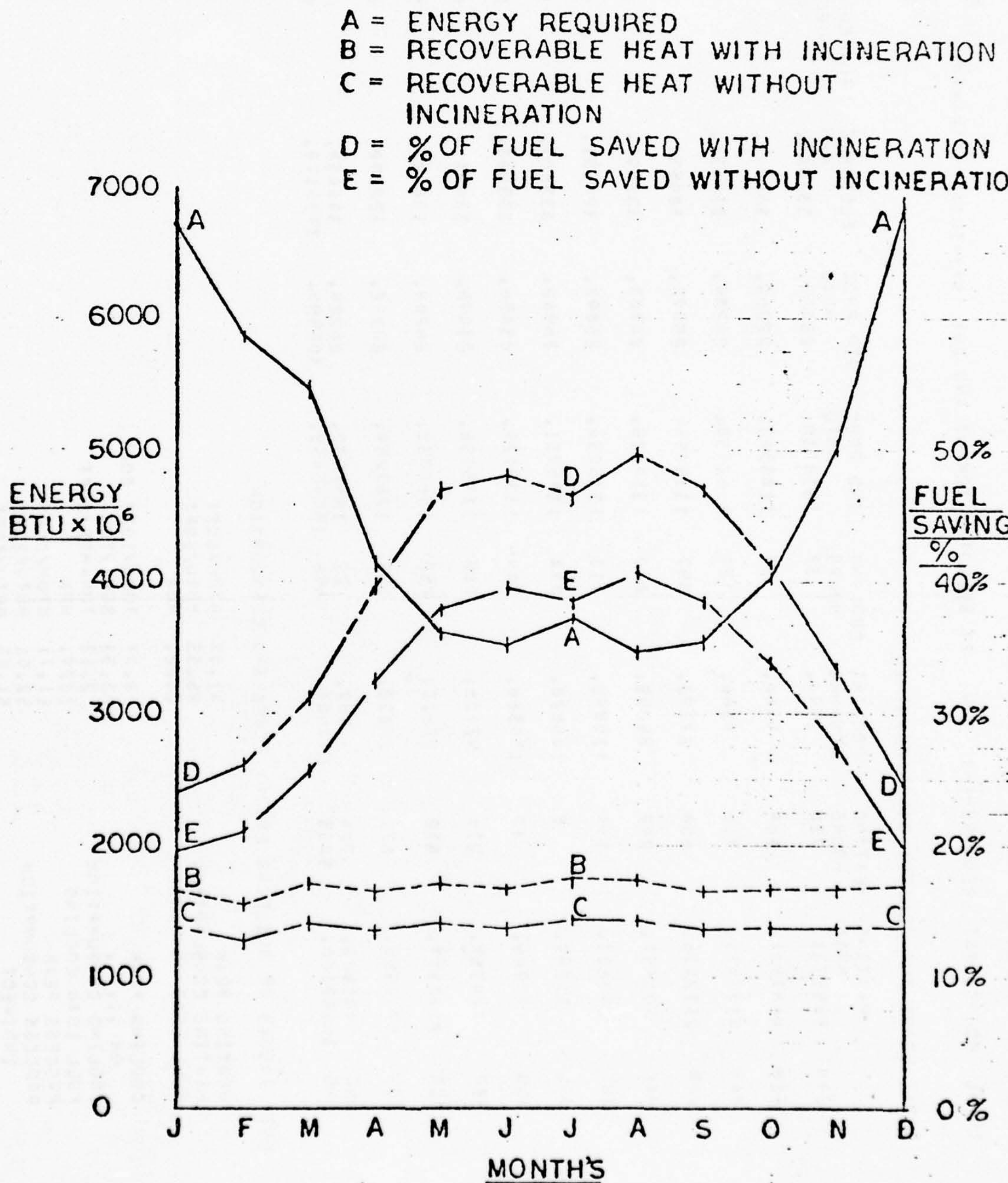
Chkd. By________ Date________

Sheet________ of ________

Job No. 4430

Project MIUS FT. BELVOIR, VIRGINIA Structure TOTAL SITE

For ENERGY REQUIREMENT, RECOVERABLE HEAT & FUEL SAVING'S



TOTAL COINCIDENT REQUIREMENT FOR FT BELVOIR, TCR007 AND 008 ****TOTAL SITE**** *Fig. 4*

COUNT OF HOURS AT 10 PERCENT INCREMENTS OF ASSUMED PEAK LOADS *150 T* *190 T*

Load	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90	91-100	100+
HEATING	445	970	1069	996	939	694	266	64	0	0	0
COOLING	2659	585	454	494	346	143	15	0	0	0	0
INDIRECT PROCESS	440	875	1355	1645	1385	1530	765	765	0	0	0
DIRECT PROCESS	990	1425	510	365	510	510	510	255	255	0	0
ELECTRIC	0	0	0	2045	985	330	1935	1640	1205	620	0

FIG 10

Fort Belvoir, VA.
1200 EM Barracks

Plant Equipment Selection
and Thermal Balance

WINTER OPERATION - Jan. 23	Site Load BTU/HR	Heat Recovery BTU/HR	Usable Load Installed BTU/HR KW
1. Heating Requirement - Profile	15,717,000	-	-
2. Domestic Water Requirement - Profile	3,517,000	-	-
3. Total Site Requirement	19,224,000	-	-
4. Electric Generation Select 4-600KW diesel generators 3 on-line, 1 in reserve			1920KW
5. Heat Recovered from engines 902 x 4000	-	3,608,000	-
6. Net Heat Requirement	15,616,000	-	-
7. Select 4 boilers each 5200MBH 3 on-line, 1 in reserve	-	-	20,800,000 B/HR

SUMMER OPERATION - Aug. 19	Site Load BTU/HR	Heat Recovery BTU/HR	Usable Load Installed BTU/HR KW
1. Refrigeration System - Required 970 x .7 x 12,000	8,148,000		
1-118 ton electric centrifugal unit	-	-	1,416,000 B/HR 120KW
1-620 ton absorption refrigeration unit	-	-	7,440,000 B/HR
2. Thermal Requirements 620 tons x 17,000	10,540,000		
3. Domestic Hot Water	3,500,000		
4. Total Site Requirement	14,040,000		
5. Electric Gen. Heat Recovery 1157 x 4000		4,628,000	
6. Net Thermal Requirement (Boiler)	9,412,000		
7. Total Boiler Capacity			20,800,000
8. Total Refrigeration Capacity			8,856,000

Chapter II

SPECIFICATIONS FOR ENGINE/GENERATORS

INDEX

SECTION 1.0 - ENGINE-GENERATOR UNITS:

1.1. PERFORMANCE:

1.1.1. The diesel engines and generators shall meet the requirements in the report "A Performance Specification for a Total Energy Plant at the Jersey City BREAKTHROUGH Site, NBS Report 10313, date and specifications for engine/generator automatic control system, chapter 3 , general and special conditions of the contract.

1.1.2. The generators shall meet the requirements of NEMA Publication MG 1-1967, Part 22 or latest revision, except as superseded by provisions of NBS Report 10313 and specific provisions of this specification.

1.1.3. Each engine-generator unit shall be rated at the selected KW, at specified voltage, 60 Hz, and at 0.8 power factor for continuous operation at 1,200 RPM.

1.1.4. Each engine generator unit shall be capable of providing 110 percent of name plate rating, at 60 Hz, and at 0.8 power factor for two hours of continuous operation at 1,200 RPM.

1.1.5. Maximum fuel rates for each engine-generator unit shall be as follows:

1.1.5.1. Based on No. 2 Diesel fuel having a gross heating value of 19,500 BTU/lb. and a weight of 7.12 lbs/U.S. gallon.

1.1.5.2.

Output KW	Gallons/Hour
150	14
300	24
450	35
600	47

1.1.6. All ratings shall be made with units completely equipped with air cleaners, air starters, fuel priming pumps, oil coolers, fuel injectors, turbo-chargers, after-coolers, waste gates, lubricating oil pumps, governors, generators exciters and simulated flue gas exhaust system. Simulate 15" W.C. pressure drop in the exhaust gas discharge.

1.2. MOUNTING:

1.2.1. Each engine-generator shall be assembled as a unit on a welded steel sub-base and shall form a rigid self-supporting structural unit suitable for handling and installation upon a concrete foundation.

1.2.2. After assembly each unit shall be statically and dynamically balanced upon its structural base and secured against movement in course of handling and shipping.

1.2.2.1. Engine-generator unit shall be well balanced at no load and at any operating load and speed, including overspeed, in the operating range. Mechanical balance shall be effected by the use of steel balance weights attached by non-corrodible bolts securely locked, by steel weights, dovetailed and suitably anchored in balancing grooves, by drilling out material, or by securely welded steel weights. The use of babbitt or lead as a balancing medium should not be permitted. There shall be no objectionable vibration at 25% overspeed or at any load speed either before or after assembly with the prime mover for which the generator is intended. Measurements of vibration taken before assembly with the prime mover shall not exceed the limits specified for type II of Standard MIL-STD-167. After assembly with the prime mover the vibration shall not exceed the vibration limits of the combined unit.

1.2.2.2. Dynamic Balance

Limits of unbalance - The engine-generator set rotor shall be balanced dynamically to such a degree that at rated speedsof the unit the remaining unbalanced centrifugal force in either of the planes of correction shall not exceed the limits specified for type II of Standard MIL-STD-167, which are determined by formula:

$$U = \frac{4w}{n}$$

U = unbalance

W = weight of rotar

n = operating speed

1.2. <u>MOUNTING</u>: (continued)

1.2.3. A removable wooden skid base should be applied for shipment and installation.

1.2.4. Units should be set on primary spring loaded concrete inertia bases.

1.2.5. Primary inertia bases should be set on concrete inertia blocks recessed in floors. Blocks should be separated floor structure with pre-compressed glass fibre pads.

1.2.6. Vibration isolator pads and springs should be as designed and furnished by manufacturer and as approved by Engineer.

1.2.7. The vibration isolation components for the engine-generators should protect all adjacent and surrounding occupied buildings and spaces outside the plant building for vibration in excess of the Recommended Limit valves shown in Fig. 1.

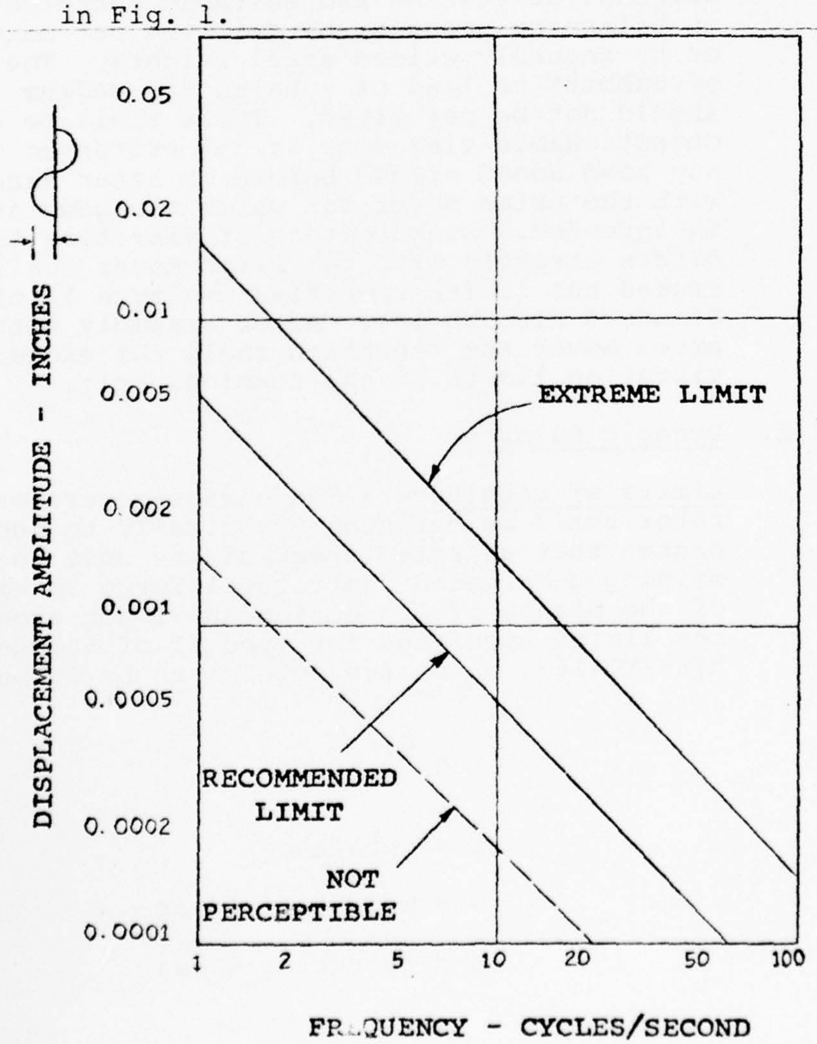


FIGURE 1

1.3. PREINSTALLATION TESTS AT MANUFACTURER'S PLANT:

1.3.1. It is the intention that operational and performance tests of each unit be completed in the manufacturer's plant to an extent requiring a minimum of field adjustment of any part of the complete operational assembly.

1.3.2. Government representatives should witness operational and performance tests pre-requisite to acceptance of each unit for shipment to job site.

A subcontractor to the government representative should review design of rotating and reciprocating element of engines and generators and the shaft couplings for vibration, alignment and torsional problems. He will install acoustic and vibration transducers on or in the engine-generator units to produce or prepare a signature of the units at various load levels while the units are under test at the manufacturer's facilities. The signatures will be analyzed to reveal sound and vibration frequencies related to the operating speed of the various components as to their natural vibration frequencies. He will also study the engine lubrication system with a view to sampling techniques for spectrographic analysis and maintenance schedules. Engine manufacturer should notify engineer and government representative 2 weeks prior to time when all engine-generator units are ready for testing. Engine-generator units to be equipped with all components as specified.

1.3.3. Manufacturers' Tests - The manufacturer shall make, previous to the tests to be witnessed by the government representatives, sufficient tests to insure that the design of the generator set conforms in all respects to the requirements of this specification. To prevent delays and the additional cost of repeated tests, not more than two witnessed tests shall be made on any unit, the second test to be made within such time after the first test as arranged by the government representative. Failure to make the necessary repairs or remedy defects within that time shall be considered sufficient cause for the final rejection.

1.3.3.1. Pressure Tightness - The method of assembly and the tightness of joints of engine piping systems, engine jackets, heat exchangers, after being fully assembled on the engine, shall be tested under pressure equal to a test pressure 50 percent in excess of the working pressure and at specified operating temperature.

1.3. <u>PREINSTALLATION TESTS AT MANUFACTURER's PLANT:</u> (continued)

1.3.4. <u>Witnessed Tests</u> - All tests shall be conducted with the engine-generator set operated as a complete unit with all auxiliaries as specified. The standard Federal Government factory test record forms shall be used.

1.3.4.1. <u>Generator air-gap</u> - The minimum air-gap between the rotor and startor iron shall be carefully measured and recorded when the unit is cold and again after the 2-hour running period at 110% rated load as described in paragraph 1.3.4.6. The air-gap shall be measured by suitable steel feelers or gages. The measurements shall be made in at least 8 places approximately 45 mechanical degrees apart, with at least 1 of the measurements made at the bottom.

1.3.4.2. <u>Compressed air starting</u> - The generator shall be subjected to seven starts consisting of cranking the assembled generator set until the engine fires, then stopping the engine and repeating the procedure as soon as the set comes to rest. This test shall be conducted with the engine in a cold condition.

The following data shall be obtained:

1.3.4.2.1. The minimum quantity of air expressed in cubic feet of free air at 14.7 psi and 68° F. for the cold start.

1.3.4.2.2. The minimum quantity of air expressed in cubic feet of free air at 14.7 psi and 68° F. necessary for each of seven successive starts, including the cold start.

1.3.4.2.3. The minimum air pressure at which the unit will start within a 5-second time limit.

1.3.4.2.4. A recording shall be made of the acoustic and vibration signature during each startup.

1.3. PREINSTALLATION TESTS AT MANUFACTURER'S PLANT: (continued)

1.3.4.3. Governor Tests - The following tests shall be made of the engine-governor after the unit has been operated for one hour at full load.

1.3.4.3.1. Load Speed Test

1.3.4.3.1.1. At no load, and with manual control of generator excitation, the generator set shall be adjusted to rated speed and rated voltage.

1.3.4.3.1.2. The load shall be changed in 20 percent increments from no load to 100 percent load and back to no load. At each point, the voltage shall be adjusted to rated value, and the speed recorded.

1.3.4.3.1.3. The load speed curve shall be plotted and furnished as part of the test data.

1.3.4.3.2. Sudden Load Change

1.3.4.3.2.1. The generator set shall be adjusted to rated speed, and voltage and 70% rated load. A 100 hp motor load (0.8 power factor) shall then be applied and after steady conditions have been reached shall be disconnected. This test shall be repeated 5 times but with disconnecting the motor immediately after motor starts rotating.

1.3.4.3.2.2. Readings of voltage change, overspeed, underspeed and recovery time shall be recorded. The method of measuring the voltage, speed changes and recovery time shall be as directed by the government representative.

1.3. PREINSTALLATION TESTS AT MANUFACTURER'S PLANT: (continued)

1.3.4.3.2.3. Overspeed governor - During this test, the regulating governor shall be made inoperative. The engine speed shall be increased above rated speed until the overspeed governor functions. The speed at which the overspeed governor is set to function shall be determined and recorded.

1.3.4.4 Operation of temperature and flow controls - With the unit operating at full load, the temperature of the cooling water and the temperature of the oil shall be made to rise gradually in separate tests until the safety devices function to stop the unit. The actuation temperature of these devices shall be recorded.

In seperate tests, interruption to the flow of oil and the flow of cooling water shall be simulated. The time required to stop operation of the unit shall be recorded together with any operating conditions that might endanger the life of the unit.

1.3.4.5. Dielectric Tests - The insulation resistance of the generator windings, both rotating and stationary, shall be determined in accordance with NEMA Standard MG 1-1963.

1.3.4.6. Steady operation tests - The engine-generator unit shall be operated at rated speed and voltage and at six load increments; namely, 0, 25, 50, 75, 100, and 110% rated load in accordance with the following schedule:

Start with 2 hr. at 100% load

then 2 hr. at 110% load

1 hr. at 75% load

1 hr. at 50% load

1 hr. at 25% load

1/2 hr. at 0% load

1.3. PREINSTALLATION TESTS AT MANUFACTURER'S PLANT: (continued)

1.3.4.6. Except for a shut-down period to measure the generator air gap after the 2-hour running period at 110% load, the above-running schedule shall be continuous.

The following data shall be recorded at 20-minute intervals during each of the above periods of steady operation:

Time.
Ambient air temperature at engine air inlet.
Barometric pressure.
Lubricating oil pressure and temperature.
Jacket-cooling water temperature at inlet and outlet.
Jacket-cooling water flow rate and pressure drop.
Combustion gas temperature.
Fuel pressure.
Fuel used.
Engine speed.
Back pressure on exhaust.
Generator field and armature winding temperature.
Generator and exciter frame temperature.
Generator bearing temperature.
Voltage.
Current.
Frequency.
Power factor.
Generator load, kw.
Exciter current.
Acoustic and vibration signature as described in 1.3.2.
Oil cooler, turbo-charger and after cooler water coolant circuit water temperatures at inlets and outlets.
Oil cooler, turbo-charger and after cooler water coolant circuit flow rates and pressure drops.

1.3.5. Preparation for Shipment _ Upon completion of test and approval for shipment by purchaser's representative all fuel and water connections shall be sealed to prevent entrance of foreign matter of damage to threads or fittings. Electrical connections shall be covered with waterproof tape or other suitable material. The entire assembly shall be cleaned and encased in durable weatherproof material for shipment.

1.4. <u>FIELD TESTING AND STARTING:</u>

1.4.1. Engine generator units shall be tested by manufacturer in plant rechecked in field.

1.4.1.1. Fuel consumption at 25%, 50%, 75%, 100% and 110% at rated load.

1.4.1.2. Electrical shorts and defects.

1.4.1.3. Operation of safety controls.

1.4.1.4. Frequency and voltage variations at both constant load and varying loads from 0% to 50% and 25% to 100% of rated loads.

1.4.2. Engine-generator unit supplier to state with his equipment proposal all tests to be required of control manufacturer and approval in writing the certified tests furnished by the Control System Manufacturer.

1.4.3. All factory and field tests shall be certified by manufacturer to Engineer in writing.

1.4.4. Engine-generator supplier to make arrangements for and witness testing of control system equipment at jobsite.

1.4.5. Provide load banks for testing the units at not less than 2,000 KW load.

1.4.6. After initial startup has been completed, the engine supplier shall provide factory trained personnel for testing of equipment plus not less than 10 days of instruction to the operating personnel of the plant. Maintenance manuals, as built drawings, parts lists shall be bound into a binder.

1.5. <u>FIELD ADJUSTMENT</u>:

1.5.1. Each engine-generator unit shall be checked for alignment by the supplier after units are installed.

1.5.2. Inspect and certify all engine and generator control wiring prior to system start-up. Inspection shall be done at the same time that the control system manufacturer inspects the engine units.

1.5.3. The Engine Manufacturer or his representative shall be responsible for field supervision during system start-up for a minimum cumulative period of not less than 5 days per engine.

The Engine Manufacturer or his representative shall provide at least one regularly employed service mechanic for the full start-up period.

In addition, the Engine Manufacturer or his representative shall make available and provide the site, when requested by Engineer, for an aggregate period of 10 working days, the regularly employed service manager. All other personnel used in the system start-up shall be pre-qualified by the engineer.

1.5.4. Engine-generator unit supplier shall provide all lubricating oil and fuel required for field testing.

SECTION 2.0 - ENGINES:

2.1 ENGINES, GENERAL:

2.1.1. Engines may be turbo-charged, after-cooled, water cooled, compression ignition, 4-stroke cycle type with pre-combustion chambers, cyclinders in - 'V' arrangement. Compression ratio shall not exceed 15.5:1.

2.1.2. Continuous duty rating and overload rating shall be of sufficient size to conform to Performance Section of this specification under the specific operating conditions applicable to this installation.

2.1.3. Operating speed shall be 1,200 RPM.

2.1.4. Each engine shall be equipped with the following:

2.1.4.1. Full pressure lubricating system.

2.1.4.2. Forged crankshaft.

2.1.4.3. Dry air cleaners.

2.1.4.4. Water cooled manifolds, water cooled jackets, and sloped water outlet risers.

2.1.4.5. Oil filters and oil coolers.

2.1.4.6. Air starting system with solenoid valves and pressure regulator.

2.1.4.7. Safety controls.

2.1.4.8. Constant lubricating oil pump and running lubricating oil pump.

2.1.5. Engine crankshaft, generator shaft and coupling shall be both statically and dynamically balanced.

2.2 <u>ENGINES, AUXILIARY LUBRICATING OIL SYSTEM</u>:

2.2.1. Provide, on each engine, an engine mounted 110 volt, a fractional HP-1ø, motor driven, constant lubrication pump at 1.5 GPM at pressure designated by the engine manufacturer as an auxiliary lubricating oil system for the engine in addition to the engine drive pump.

2.2.2. Provide auxiliary oil pressure switch relay to operate lubrication pump when engine is not operating.

2.2.3. Provide engines with automatic oil level controllers.

2.3 <u>ENGINES, GOVERNOR</u>:

2.3.1. Provide hydraulic actuators with feedback potentiometer.

2.3.2. Actuator is to be adjusted to exhibit a slow drift in the closing direction with no electrical signal.

2.3.3. Provide a maximum rate of 72 degrees per second per volt gain.

2.3.4. Provide N.O. contact for all protective shutdown and signals.

2.4 <u>ENGINES, SAFETY CONTROLS</u>:

2.4.1. Provide the following automatic safety controls for each engine:

2.4.1.1. Low lubricating oil pressure-two stage, signal alram and shutdown of engine (40 psi, 20 psi).

2.4.1.2. High jacket water temperature-two stage, signal alarm and shutdown of engine (240°F., 252°F. adjustable).

2.4.1.3. Underspeed - 40% (480 RPM).

2.4.1.4. Overspeed - 105% (1260 RPM).

2.4.1.5. High oil temperature-two stage, signal alarm and shutdown of engine (200°F., 220°F.).

2.4.1.6. High oil coolant temperature alarm - 150°F.

2.4.1.7. Excessive vibration - two stage - signal alarm and shut down.

2.4.1.8. Oil filter differential pressure switch alarm.

2.4. ENGINES, SAFETY CONTROLS: (continued)

2.4.2. When anyone of the safety controls is actuated, the engine shall shutdown and also actuate an alarm on the control panel.

2.4.3. Provide leads from each safety control to terminal box of engine. Provide wiring diagram for field connections.

2.4.4. Safety switches to be as specified in specifications for engine-generator automatic control systems.

2.5 ENGINES, VENT:

2.5.1. Vent the engine crank case to a CECA crankcase emission control system. Connect emission control system to both intake manifolds in strict accordance with CECA instructions.

2.6. ENGINES, STARTING:

2.6.1. Engines shall be started by compressed air starting systems.

2.6.2. Starters shall have sufficient capacity to crank the engines in on ambient temperature of 10°C. and at a speed which will start the diesel engines under design operating conditions. Minimum speed of engine - 480 RPM.

2.6.3. The starter pinions shall be so arranged as to disengage automatically when engine starts.

2.6.4. Provide 24 volt D.C. solenoid valves for compressed air - ASME approved 250 psi W.P.

2.7. ENGINES, STARTING CONTROLS:

2.7.1. Automatic controls shall be furnished to provide for automatic cranking of the engine on a 24 volt signal from the control system.

2.7.2. Starting controls shall be designed to prevent excessive cranking.

2.7.3. Provide a hand-off automatic switch to operate the engine manually.

2.7.4. On a signal from the control system the engine shall crank for 10 speed intervals (6 maximum) 10 seconds apart.

2.7. ENGINES, STARTING CONTROLS: (continued)

2.7.5. If engine fails to start, a malfunction signal shall be transmitted to the control panel and engine failure indicated.

2.8. ENGINES, TURBO-CHARGER-AFTER COOLER, COOLING SYSTEM:

2.8.1. Engine, turbo-chargers - after coolers will be provided with cooling water from controlled cooling systems.

2.8.2. Cooling water shall enter the engine after coolers at 105°F. and 30 Psig.

2.8.3. Each engine will be provided with recommended water flow for cooling water.

2.8.4. Maximum pressure drop through the turbo charger, after-cooler circuit shall be as designated by manufacturers for the recommended cooling water flow.

2.8.5. Cooling water will be provided from a sealed system.

2.9. ENGINES, JACKET COOLING SYSTEM:

2.9.1. Engine jacket will be provided with cooling water from a controlled cooling systems.

2.9.2. Cooling water shall enter the engine jacket at 225° E.W. and 50 Psig. In the event that the generator load exceeds 75 to 80% of the maximum engine generator rating, the cooling water temperature will be automatically reduced to limit the jacket outlet temperature to 180°F.

2.9.3. Each engine will be provided with manufacturers' recommended flow of cooling water.

2.9.4. Maximum pressure drop through the engine jacket shall be as recommended by manufacturer.

2.9.5. Cooling water will be provided from a sealed system.

2.10 ENGINES, OIL COOLING SYSTEM:

2.10.1 Engine oil coolers, will be provided with cooling water from controlled cooling systems.

2.10.2 Cooling water shall enter the engine oil coolers at 140°F. and Psig.

2.10.3. Each engine will be provided with 100 GPM of cooling water.

2.10.4 Maximum pressure drop through the engine oil, cooler, shall be 3 psi at 100 GPM.

2.10.5. Cooling water will be provided from a sealed system.

SECTION 3.0 - GENERATORS:

3.1. GENERATOR CAPACITY:

3.1.1. Each generator shall be wound for 277/480 volt, three phase, four wire, 60 cycle operation.

3.1.2. Each generator shall be rated at nameplate, continuous duty and 110% overload operation for 2 continuous hours at 0.8 power factor.

3.1.3. Generators shall be able to operate in 40°C. ambient temperature with 70° C. temperature rise.

3.2. GENERATOR, CONSTRUCTION:

3.2.1. Generator shall be the following type:

3.2.1.1. Single bearing revolving field type of brushless design with rotary exitation and a static voltage regulator. Voltage regulator and rehostat supplied by the generator manufacturer shall be furnished to the control system manufacturer for installation.

3.2.1.2. All components shall be the product of a single manufacturer to assure proper coordination of electrical equipment. Generator and exciter shall use Class B insulation. Magnet wire and insulating varnish shall be class F.

3.2.2. The voltage shall be externally regulated within 0.7 seconds to 1% (4.8 volts) from no load to full load, and constant from 25% to 100% of full load.

3.2.3. Generator shall be connected to the engine fly wheel through a coupling as approved by Engineer.

3.2.4. Provide generators with damper windings and cross-current compensations.

3.2.5. The generator shall be drip-proof, endwise ventilated and shall employ a single blower mounted on the drive end of the rotor shaft.

3.2.6. Generator Stator core shall be built up of high grade silicon steel laminations precision punched, deburred, and individually insulated. Stator coils shall be random wound and inserted in insulated core slots.

3.2. GENERATOR, CONSTRUCTION:

3.2.6. Wound core shall be repeatedly treated with thermosetting synthetic varnish and baked for maximum moisture resistance, high dielectric strength, and high bonding qualities. Armature lamination followers and frame ribs shall be welded integral with frame. Enclosure shall be dripproof.

3.2.7. Generator Rotor poles shall be built up of individually insulated silicon steel punchings. Poles shall be from wound and bonded with high strength varnish, then baked. Cage connections shall be brazed for strong construction and permanent electrical characteristics. Each pole shall be securely bolted to rotor shaft.

3.2.8. Bearings shall be double shielded and pre-lubricated. Grease in the bearing enclosure shall provide additional lubrication to bearing as well as provide sealing against dirt and moisture. Designed bearing life, based on B-10 curve of the Anti-Fricition Bearing Manufacturers Association, shall be 5 years.

3.2.9. Terminal Box shall be adequate size, located on the end of the machine. It shall be constructed so that leads may be brought out either side without reconnection or rework.

3.2.10 Controls: Control cubicle shall be vibration isolated and mounted on top of terminal box enclosure. Voltage regulator, voltage adjusting rheostat, ammeter, and voltmeter shall be standard-equipment and mounted inside control cubicle.

3.2.11. Voltage Regulator shall be a hermetically sealed, silicon controlled rectifier type and shall employ a zener reference. The voltage regulator will provide automatic protection of the entire unit on 3-phase short circuits. The voltage regulator shall include automatic underfrequency protection to allow the generator to be operated no load, at less than synchronous speeds, for engine start-up and shutdown procedures. Switches and/or fuses shall not be used to provide this protection. Voltage regulator shall be compatible with/and as approved by manufacturer of engine-generator automatic control system.

3.3 GENERATOR-EXCITER:

3.3.1. Exciter capacity shall be able to produce ample excitation to the generator under all load conditions.

3.3. GENERATOR-EXCITER: (continued)

3.3.2. Exciter shall be direct connected to the generator.

3.3.3. Maximum field for exciter to be 6 amps, 90 volts.

3.3.4. The generating unit rotating rectifier assembly shall be a 3 phase, full wave bridge to provide DC power to the generator field.

3.4. GENERATOR, OPERATING CHARACTERISTICS:

3.4.1. Short circuit capacity - 300% current overload for 10 seconds without mechanical or electrical damage to the generator and without tripping the unit circuit breaker.

3.4.2. Waveform-the unit operating at rated voltage and frequency at any balanced unity power factor or 0.8 power factor load between no load and full load, the following requirements apply:

3.4.2.1. Line-to-Line

Single harmonic content - 2%
Total harmonic content - 3%

3.4.2.2. Line-to-Neutral

Single harmonic content - 3%
Total harmonic content - 5%

3.4.3 Phase Balance -maximum difference in the line-to-neutral voltages at no load not to exceed 1% of rated L-N voltage.

3.4.4 Unbalanced Load-voltage unbalance with single-phase load up to 25% of rated current not to exceed 5% of rated voltage.

3.4.5. Performance: Voltage regulation shall be within ± 2% of rated voltage from no load to full load. Steady state modulation shall not exceed ± 1/2%. Instantaneous voltage dip shall not exceed 16% of rated voltage when full load at rated power factor is applied. Recovery of stable operation shall occur within 1/2 second.

Chapter III

SPECIFICATIONS FOR ENGINE/GENERATOR

AUTOMATIC CONTROL SYSTEM

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ECTION 1.0 SCOPE

1.1. Intent

1.1.1. The control system described in this specification is intended to provide all required control functions for a completely automatic Total Energy System. The control panel shall include the circuit breakers, all of the normal control circuitry and the protective functions required for each engine-generator unit and associated instrumentation. The control system shall comply with all the applicable provisions of NBS report 10313 1975 and entitled "Performance Specifications for a Total Energy Plant at Jersey City Breakthrough Site". The system shall be completely automatic, designed for normally-unattended operator control, adding and subtracting units to match the electric load demand imposed by the building complex and shall include the necessary devices for monitoring the system, including all safeties and alarms. In addition, provision shall be made to permit complete manual operation of the system as hereinafter specified. It shall be the responsibility of the manufacturer to insure the overall compatibility of each control element including, but not limited to, actuators, governors, circuit breakers, alarms and safeties, batteries, battery chargers, voltage regulators, instrumentation and system logic.

1.1.2. The purpose of the above requirement is to provide the government and Engineer with a single sourceof responsibility for the entire engine-generator control system.

1.2. Installation and Installation Drawings

1.2.1. Five sets of shop drawings shall be submitted for approval to the Engineer before fabrication. They shall be transmitted via the channels established for handling of shop drawings within two weeks after contract is let for the control switchgear.

Drawings shall show layout of all components, space requirements, clearance requirements, provisions for hoisting and erection, weights and other data needed for installation and shall contain a descriptive sequence of operation of the entire system. They shall show all electrical connections required in the field, both internal and external, to the equipment, together with wire sizes and types and wire numbers.

1.2.1. They shall also show all internal components and internal wiring including part numbers. Drawings will be approved by the Engineer for compliance with plans and specifications.

1.2.2. Refer to specification or Engine/Generators for Total Energy Plant corrolation of requirements between control system and engine/generators.

1.2.3. The control switchgear manufacturer shall check out installation of his equipment during construction and provide assistance to the Installing Contractor as may be required. Initial startup and testing of the equipment shall be made by a factory-trained representative of the Control Contractor as hereinafter provided.

1.3 Functional Performance

The control panel shall provide the following functions:

1.3.1. Engine Generator Controls

A separate control cabinet shall be provided for each of the generator units. This unit control shall contain a circuit breaker and provide the functions of speed control, real load division, voltage regulation, reactive load division, engine and electrical system start sequencing, alarms, and protection from undesirable operating conditions. It shall be designed to operate with a master control unit which coordinates all units in attaining the desired system performance. Meters and indicating lights shall be provided to present the operating condition of the unit. Selection of automatic, manual or test mode control shall be provided along with provisions to lock the unit out of service. All essential controlling modules shall be plug-in type (except for high current circuits) for easy serviceability. All unit modules shall be interchangeable with one another and identical in construction and shall be of solid state design.

1.3.2. System Master Control

A system master control shall be provided to coordinate the operation of the system. It shall be designed to provide for completely automatic system operation, but shall operate properly when any or all units are in the manual mode. The functions provided by the master control shall include automatic start and stop sequencing of

1.3.2. units in response to the system load demand. Stops and starts shall be according to a preselected sequence of the units and shall allow for variation in the start/stop sequence. Automatic paralleling of units shall be provided with provisions to manually start and parallel units so selected. The master control shall supply all signals to the unit controls for automatic start and stop sequencing, automatic and manual paralleling and other coordinating signals. Meters and indicating lights shall be provided to indicate the status of the complete system under any operating condition. A load dump feature shall be included to signal for load reduction whenever an overload or malfunction of an operating unit occurs and to reapply this load when another unit has been started and placed in service. All controlling circuits shall be plug-in type, solid state design.

1.3.3. <u>Control System Operation</u>

1.3.3.1. For normal operation as an automatic system, the control panel shall be capable of starting the energy system and adding or subtracting units to match the load demand imposed on the system. During operation, all control functions shall be performed automatically to maintain the specified operating conditions and to protect the system and the load from undesireable operating conditions. When desired, it shall be possible to operate any or all units in the manual mode, start, stop and paralleling shall be performed manually. All control and protective features shall operate normally for units in the manual mode.

1.3.3.2. Control equipment shall be fused to protect the system from internal and external short circuits or accidental grounds. Portions of the system shall be individually fused rather than having one set of fuses protecting many types of functions.

1.4. <u>Control Panel Construction and Standards</u>

1.4.1. The control panel shall utilize cabinets of the enclosed, dead-front free-standing type. A separate cabinet shall be provided for each unit control. Access to the control circuitry, the control switches and the indicating lights shall

1.4.1. be provided by a hinged door on the front of each unit control. Meter displays shall be contained on a sloped panel at the top of each unit control. The system master control shall be contained in a separate cabinet. Access to the control circuits, control switches and to the system adjustments shall be provided by a hinged door on the master control cabinet. All indicating lights displaying the operating status of the system shall be contained on the exterior of the door. Meters displaying system operation shall be mounted on a sloped panel at the top of the master control cabinet and on the exterior of the door.

1.4.2. The design, construction and performance of the Total Energy plant control system shall be in accordance with the provisions of the following standards:

USAS C37.20 - 1969 Switchgear Assemblies Including Metal-Enclosed Bus and Supplement ANSI C37.20a -1970.

USAS C37.19 -1963 or latest revision, Safety Requirements for Low-Voltage AC Power Circuit Breakers to Switchgear Assemblies.

USAS C37.1 -1962 or latest revision, Relay and Relay Systems Associated with Electric Power Apparatus.

NEMA SG - 1965 Low Voltage Power Circuit Breakers.

NEMA SG5-1971 Power Switchgear Assemblies.

1.5. Manufacturer's Qualifications

Manufacturer shall demonstrate to the satisfaction of the Engineer and government that he has supplied equipment in substantial compliance with these specifications and such equipment has been in satisfactory operation in at least three similar installations for a period of two or more years.

1.6. Space Limitations

The entire assembly shall be sized to fit the project and not to exceed 4 feet in depth and 7 feet in height and shall face in one direction. Assembly shall include:

1 active Engine/generator modules
1 future (space only) Eng/Gen. module
1 Control module (Master)
1 Tie and Utility Connection breaker module
1 Temperature control (empty) module
1 Instrumentation module

1.7. Manufacturer's Pre-Installation Tests

1.7.1. The manufacturer of the control switchgear assembly shall perform the Design Tests and Production Tests specified in USAS C37.20-1969 and Supplement ANSI C37.20a-1970 and in NEMA Standards Publication No. SG3-1965 or latest revision, on each replicated and non-replicated component. These tests shall be performed in the manufacturer's plant or in a laboratory acceptable to the government.

1.7.2. The manufacturer of the relays and relay systems in the plant control system shall perform the Dielectric Tests and Performance Tests specified in USAS C37.1-1962 or latest revision, on each replicated or non-replicated component, either in the manufacturer's plant or in a laboratory acceptable to the government.

1.7.3. The manufacturer of the control systems for the total energy plant shall perform functional proof tests of the engine-generator controls, Chapter III, Section 2.0 and the system master control, Chapter III, Section 3.0 utilizing either simulated signals to activate the controls or an actual engine-generator unit. These functional tests shall cover all performance sequences described in the specification and shall be performed in the manufacturer's plant or in a laboratory acceptable to the government.

1.7.4. Field dielectric tests shall be made of the entire assembly and all relays and relay systems after installation during acceptance testing of the plant, in accordance with the provisions of USAS C37.20-1969 and Supplement ANSI C37.2a-1970 and also USAS C37.1-1962 or latest revision.

1.7.5. In addition, the manufacturer of the control systems shall demonstrate performance of these systems in accordance with the specifications during the acceptance test of the total energy plant after installation.

SECTION 2.0 ENGINE GENERATOR CONTROLS

Each unit control shall provide the following functions:

2.1. Speed Control and Real Load Division

2.1.1. An electronic speed control shall be provided to maintain a constant steady-state frequency to an accuracy of $\pm$ 0.25% of rated speed.

2.1.2. During parallel operation, the real load shall be divided equally among units to an accuracy of $\pm$2% rated unit load.

2.1.3. The speed control shall be designed to limit speed overshoot on engine start to less than 2% (24 RPM) of rated speed, shall be solid state design and shall allow isochronous operation of all engine-generators in parallel. Real load division circuit shall issue signal to on-line unit speed controls, causing reduced throttle position of machines carrying too much real load and increased throttle positions of machines carrying too little real load. Transient speed variation shall be less than 0.4 Hz for sudden load changes up to 25% of full load of generator rated capacity and the recovery of the controlled speed shall occur within 4 (four) seconds. Overshoot on startup shall be limited to 24 RPM at 60 Hz. Speed sensing of each engine generator shall be based on the frequency and voltage generated by the corresponding engine generator set. The speed control shall be designed to operate a hydraulic actuator equipped with induction potentiometer to provide position feedback signals to the control. The induction potentiometer shall be shielded from electrical interference.

2.2 Voltage Regulation and Reactive Load Division

2.2.1. A static voltage regulator will be provided by the engine manufacturer to maintain the alternator output voltage constant to an accuracy of $\pm$ 1% of rated voltage from 25% to 100% of full load and within .4 cycles from 0 to 100% of full load.

2.2.2. During paralleled operations the real and reactive load respectively shall be divided among the alternators to an accuracy of $\pm$5% of rated load. Voltage regulator to sense unbalance in proportional division of loads between on-line units and issue signal to cause an increase or decrease of exciter output voltage as required to hold balanced accuracy in load division.

2.3. Unit Start and Stop Sequencing Controls

2.3.1. Sequence control panel shall be provided to perform the functions necessary to start and stop the engine and electrical system. Upon the receipt of a unit start-stop signal from the master panel the following actions shall be required.

2.3.1.1. To apply 30 volt DC power to the air starter and fuel solenoids.

2.3.1.2. In response to a signal that 20-30% (240-360 RPM) of rated engine speed has been reached or that oil pressure is obtained on starting, power shall

2.3.1.2. be removed from the starter solenoid.

2.3.1.3. When the engine reaches 90% (1, 080 RPM) of rated speed operation of the speed control and voltage regulator shall be initiated and the master control shall be informed that the unit is available for paralleling.

2.4. Protective Functions

Whenever an undesirable operating condition as listed in Sections below is identified, the unit control shall shut down the unit and lock it out of service. The specific malfunction shall be identified and a signal shall be sent to the master control indicating that the unit has shut down as the result of a malfunction. Before the unit can be returned to service, the unit must be reset by turning the lockout key to off and back on. The following protective features shall be included.

2.4.1. Engine Protection

Each sequence shall contain the following protective sensing devices. Malfunction indication with memory to indicate the following conditions with lockout until manually reset (first-out condition, only maintaining). The setting of the protective sensing devices shall be as called for in the Engine/Generator Specifications.

2.4.1.1. Mechanical

2.4.1.1.1. Low oil pressure, protection shall be locked out during startup until engine reaches 90% speed-two stage signal, alarm and shutdown to signal at remote location.

2.4.1.1.2. High water temperature-two stage signal, alarm and shutdown.

2.4.1.1.3. High oil temperature-two stage signal, alarm and shutdown.

2.4.1.1.4. Overspeed-two stage.

2.4.1.1.5. Underspeed-two stage.

2.4.1.1.6. Vibration-alarm and shutdown.

2.4.1.1.7. High oil coolant temperature.

2.4.1.1.8. Two extra circuits for use.

2.4.1.2. Electrical

2.4.1.2.1. Circuit breaker trip.

2.4.1.2.2. Excessive start time.

2.4.1.2.3. Overload.

2.4.1.2.4. Failure to parallel.

2.4.1.2.5. Reverse power protection.

2.4.1.2.6. Underspeed.

2.4.1.2.7. Overvoltage.

2.4.1.2.8. Undervoltage.

Each engine shall be equipped with air or fuel cut off valve air damper. The damper shall be de-energized under normal operating conditions and energized to close at emergency shutdown only.

2.4.1.3. Alarms

Monitor and issue an audible alarm warning of occurence of any non-damaging abnormal conditions. Alarm conditions shall have memory circuits with indicating light, alarm silence switch and an alarm selector switch, incorporated on same panel for easy serviceability. Sufficient contact shall be provided for remote indicator.

2.5. Coordination with Master Control

2.5.1. The unit control shall provide the following signals to the master control.

2.5.1.1. Selection of unit for manual or automatic control.

2.5.1.2. Gross malfunction.

2.5.1.3. Unit ready

2.5.1.4. Unit starting

2.5.1.5. Unit started.

2.5.1.6. Unit on line.

2.5.1.7. 40% and 90% load adjustable signals.

2.6. Mode of Operation

2.6.1. Automatic. All functions performed automatically engine-generators shall be automatically brought on line, or dropped off as load demands; except that the minimum number of units on line may be set to any number of units that override the auto-load sense circuits.

2.6.2. Manual. For a given unit start, stop and paralleling shall be performed manually only; however, all controls and protective functions shall operate in the normal manner.

2.6.3. Test Steady state operation, it shall be possible to test the unit while any or all of the remaining units are on line without affecting the operation of the system. Also test operation can be made either manually or automatically with the breaker in the draw-out test position, with all controls and protecting functions operating to extent possible.

2.6.4. Control logic and switching shall be such that all normal switching functions can be performed by the operator with equipment in operation and without inadvertently tripping engines off the line or otherwise causing malfunctions.

2.7. Unit Sequence Accessories

2.7.1. Auto-manual-test selector switch, key operated lock-out switch, manual start-stop and circuit breaker open push button switches, all associated relays, sequencing circuits, malfunction memory circuits, malfunction indicator, and malfunction selector switch panel shall be designed for easy serviceability and one source responsibility.

2.8. Unit Metering

2.8.1. A.C. ammeter with selector switch to monitor current in any phase.

2.8.2. A.C. wattmetter with adjustable double set points to read unit KW.

2.8.3. Run time meter to read accumulated engine operating hours.

2.8.3.1. Unit meter panel shall display the

2.8.3.1. state of engine with the following indicators:

2.8.3.1.1. Run indicator.

2.8.3.1.2. Alarm indicator.

2.8.3.1.3. Alarm silence indicator.

2.9. Circuit Breakers

2.9.1. Shall be electrically operated, draw-out, air circuit breaker with necessary auxillary switches and protective devices to operate the system. Closing mechanism operating motor shall be 120 V.A.C., tripping coil shall be rated 30 V.D.C.

2.9.2. Maximum closing time for breaker shall be 5 cycles. Maximum opening time for breaker shall be 5 cycles-motor operation, 1/4 cycle fault trip.

SECTION 3.0 SYSTEM MASTER CONTROL

The system master control shall be designed to coordinate the operation of the units and to perform common control functions. These shall include the following functions:

3.1. Provision for Automatic and Manual Control

The master control shall provide for automatic or manual operation of the units in accordance with their selection. For units placed in automatic, startup or shutdown shall be on the basis of load demand or a manually initiated command and paralleling shall be automatically performed. For units placed in manula, start, stop and paralleling must be performed mnaually. The master control shall include provisions to allow either type of operation for any or all units.

3.2. Sequence Selector

Shall be plug in patch-cord type to establish the order in which units can be brought on or removed from the line in numerical or any random order. Changes in engine sequence can be made without causing a disturbance to the system at any time, except during a period when a unit is being programmed on or off the line. Regardless of whether or not a unit is brought on or taken off the line either automatically or manually, the system shall be capable of automatically accounting for its condition, except if unit is in "test" position.

3.3. Load Demand Control

3.3.1. Automatic generator capacity control. This system shall function to bring on a new unit whenever the demand is within a preselected value of the rated generating on-line capability, or shall drop a unit off the line whenever an excess total generator capability exists on-line that will permit a unit to be removed and leave an access capacity of a preselected value over the existing demand. Time-delay shall be provided such that the load conditions must exist for a minimum of 1/2 minute for increasing load and not less than 5 minutes nor more than 10 miniues (adjustable), for decreasing load before action takes place.

3.3.2. Time-delay and KW values for operation shall be adjustable in the field by means of calibrated adjustment. Alarm signal, shall act as an overload and initiate start sequence of next unit.

3.3.3. Load demand sensing shall be based on the real KW load of the system vs. unit generator on-line capacity and shall issue start or stop signal to the next sequenced on or off unit. The circuit shall continuously sense the load demand of the system regardless of the mode of operation. The generating reserve capacity of on-line units shall be displayed on an optic KW meter (generating reserve-KW). Optic meter shall have double setpoint to obtain adjustment in field.

3.3.4. In addition sequence control shall be provided to automatically start a unit and close its circuit breaker whenever there are no units operating. This "dead system start" feature shall require that at least one unit be selected for automatic operation and may be disabled by a switch.

3.4. Automatic Paralleling

Automatic synchronization and paralleling of on-coming generators. The synchronizer circuit shall control the closing of the incoming unit circuit breaker when the circuit is in the "automatic" mode and shall permit closing only when voltage has built up, unit stabilized and when voltage, frequency and phase angle of incoming unit and bus are correct. Synchronizing circuits shall include identification of the proper unit, a sufficient time delay to permit speed to stabilize, activation of phase control to lock the incoming unit in phase with the bus. Phase control shall be continuously monitored. Separate synchronizing check circuit shall be used to monitor the phase difference between units and the bus. Paralleling phase relationship shall be adjustable within +15 degrees. Closure of the circuit breaker shall be effected by this circuit.

3.5 Manual Paralleling

For a unit that is started manually, the master control shall contain provisions for manually synchronizing the unit to the bus and manually closing its circuit breaker. Synchronization shall be by means of a manual speed trim control of the on-coming unit. Synchronizing and synchronizing verification lights operated by the synchronizing relays shall be provided to aid in synchronization. Closure of the circuit breaker shall be by means of a manual push-button that is active only when the unit involved is in the paralleling position.

3.6. Coordination with Unit Controls

The master control shall provide the following signals to the unit controls.

3.6.1. Automatic start and stop signals.
3.6.2. Phase control or speed trim signals.
3.6.3. Circuit breaker closing signal.
3.6.4. Signals to activate real and reactive load division following paralleling.
3.6.5. Failure to parallel malfunction signal.

3.7. Meters and Indicating Lights

The following meters and indicating lights shall be provided on the exterior of the master control to present the operating status of the system:

3.7.1. Meters

3.7.1.1. A recording voltmeter shall be provided to display and record line voltage. Two selector switches shall permit the selection of any unit or the bus.

3.7.1.2. A recording frequency meter shall be provided to display and record system frequency. This meter shall be operated from the selector switches for the voltmeter to permit frequency monitoring of the bus or any unit.

3.7.1.3. A system ammeter shall be provided with a selector switch to monitor total system current in any phase.

3.7.1.4. An Esterline Angus Series A recording wattmeter shall be provided to strip chart record total system power.

3.7.1.5. A totalizing watt hour meter with a 15-minute demand register shall be provided.

3.7.1.6. System power factor meter.

3.7.1.7. Load demand and KW reserve capacity meters shall have adjustable setpoints. One to read KW reserve of units on line, one to read total KW reserve and one to read KW demand.

3.7.1.8. Indicating meters shall be 4-1/2" diameter

3.7.2. Indicating Lights

3.7.2.1. Starting
3.7.2.2. Ready
3.7.2.3. On line
3.7.2.4. Malfunction
3.7.2.5. Overvoltage
3.7.2.6. Undervoltage
3.7.2.7. Low load
3.7.2.8. High load
3.7.2.9. Load dump
3.7.2.10. Proper selection of unit sequence selector.
3.7.2.11. Excessive vibration
3.7.2.12. Spare

3.7.3. Auxiliary Instrumentation Terminals

3.7.3.1. Terminals shall be provided on the master control panel and engine control panels to which instrumentation can be connected and disconnected while the systems are operating. These shall monitor transient phenomena on voltage control, frequency control, overspeed on startup, real load and reactive load divisions during paralleling of engines, PTC operation, load dumping, the functioning of the protective devices on the engines and the sequencing procedures of the master control. All instrumentation and wiring for external measurements shall be furnished and installed by others.

3.8. System Load Dump

3.8.1. The master control shall include a load dump feature to permit reduction of non-essential portions of the load. The load dump signal shall be generated whenever an operating unit malfunction and/or overload occurs. In the event that an electrical overload occurs on the system the following load reduction shall occur:

3.8.1.1. Load dump signal from the unit shall operate to reduce the voltage of all generators by 10% during the first stage of the load dump and simutaneously activate an alarm signal at the remote panel.

3.8.1.2. In the event of overload still existing, segments of the electrical load shall be automatically disconnected until the available equipment can provide adequate capacity. Number of load dump segments shall be determined by Engineer, but shall not be less than 8 nor more than 20.

3.8.2 Load shed shall be in sequence with 0-15 second adjustable time delay between steps until the overload condition no longer exists. When the oncoming engine-generator unit has been placed on line, and overload erased, the load shed circuits are to step the load control breakers back to line in reverse sequence from which they were dropped using the above 0-15 second adjustable timer to provide an interval between acquisition stages. In case the remaining generators fail to parallel and provide adequate generating capacity, the load shed circuit shall lock out the load control circuit breakers until an operator has rectified the problem and reset the lockout.

3.8.3. The dump load signal shall start a multi-channel recorder furnished and installed by others that will provide a record of the duration of the interruption of service to each load dump increment including plant auxiliaries.

3.9 Essential Load Control

3.9.1. In event the load dump sequence does not restore the system to normal operation, the essential load control shall open the N.C. tie breaker and close the N.O. emergency utility power connection to supply the essential load bus.

3.9.2. When proper generator voltage is re-established, control shall open utility feeder circuit breaker and close the circuit breaker. If the essential load feeder generator malfunctions while starting and system overload still exists, open essential load feeder circuit breaker No.1 and close No.3.

3.9.3. The above emergency breakers shall be interlocked so that under all conditions the utility feeder is never connected to the T.E. bus.

3.10. Time Reference Control

3.10.1. Crystal controlled, automatic system frequency control, operated from separate regenerative battery power source shall be supplied for continuous automatic system speed correction.

3.10.2 The reference oscillator and circuitry shall produce a 60 Hz signal capable of an accuracy of 1 part in 100,000 to maintain system clock accuracy within 1 minute (60 seconds) over a 30 day period.

3.10.3 The manual frequency control shall be so designed that the manual adjustment can be made in both positive and negative direction to restore the clocks to U.S. standard time as required.

3.10.4 The time reference control shall digitally display the system and standard times in true numbers showing hours and seconds properly. Shall have optic meter to show the state of system frequency compared to the reference oscillator circuits.

3.10.5. The circuit shall be designed with solid state circuitry.

SECTION 4.0 MISCELLANEOUS

4.1. D.C. Control Power

4.1.1. A common D.C. bus shall be provided in the master from which each unit control will be energized for an air start system. Battery chargers shall be mounted in unit number one and two control, switchgear cabinet. Battery charger shall be constant voltage charger with nominal output adjusted to approximate 30 volt D.C.

4.1.1.1. Battery for air start system shall be equal to Exide lead calcium, type 15 ETC 7, rated 240 amp-hours at 8 hour rate to 1.75 volts per cell. Battery shall have a nominal voltage of 30 volts D.C.

4.1.1.2. Furnish all racks, connectors, straps, and test equipment required for station-type operation.

4.2. Circuit Breakers and Accessories

4.2.1. Each circuit breaker shall be equipped with an electric operator, draw out type, air frame, shunt trip with auxiliary switches. It shall be possible to manually open and close the breaker and to observe its stage.

4.2.2. The breaker shall be equipped for 30 volt D.C. trip and A.C. power to close. Generator breakers shall be powered from the same unit alternator. The tie and emergency breakers shall be of same frame size as generator breakers.

4.3. Current Transformers

4.3.1. Current transformers shall be provided in each phase of each unit to rpovide current signal for metering, real load division cross current compensation and reactive load division. Current transformers shall be provided for each phase

4.4. Bus Arrangement, Cables

4.4.1. Copper bus shall be provided and of adequate size to handle all alternators. The bus system shall be an integral part of the generator control cubicle and rated at continuous ampere. Provide space in bottom of each cabinet for generator cable entrance. Lugs shall be provided for generator cable connections for each phase. The control panel shall be designed for system generating power 60 cycles per second and an output voltage of 480 volts, 3 phase, 4 wire, wye connected.

4.5. System Nameplates

4.5.1. Contractor shall furnish and install a single engraved nameplate on the master control module with a brief description of the system, voltage and total generating capacity, together with the names of the Owner, Site Developer, Control Equipment Supplier, the Installing Contractor and the Consulting Engineers. Nameplate shall be approved by DOD and the Engineer before fabrication.

4.5.2. All components shall have nameplates of the engraved plastic or photoetched type. Engineer shall review legends for all nameplates before fabrication. Contractor shall furnish recommended list with shop drawings for approval.

4.6. Fabrication and Wiring

4.6.1. Switchgear consoles shall comply with manufacturing standards listed in paragraph 1.1.5. Construction of switchgear, cabinets, doors, hardware, fault bracing, bus bar size and construction, arrangement of controls, meters and indicators shall be shown on shop drawings and approved by Engineer before fabrication. Minimum fault bracing 65,000 amps, RMS symmetrical.

4.6.2. All equipment shall be contained in dead-front, free-standing panels with hinged doors in front and rear arranged in such a fashion that all access to the control modules for repairs, replacement or adjustments can be made from the front. Rear access will be available for current, potential transformer and bus work. All normal control functions, status lights and metering shall be visible from the front with the doors closed. Compartments shall be electrically isolated by means of non-combustible insulation and steel. Components, and all wiring and installation shall be in accordance with applicable standards for Automatic Industrial Systems, NEMA and the National Electrical Code.

4.6.3. All conducters shall be labeled with individual identification. All conductors shall terminate on devices or numbered terminal blocks. All devices and components shall be identified by suitable markings to agree with schematic drawings.

4.7. Recommended Spare Parts

4.7.1. Control switchgear Contractor shall prepare a list of recommended spare parts to be stocked by the government for maintenance of the equipment. A cost shall be provided for each item on the list. Government shall decide whether to purchase the spares or to make arrangements with a local repair contractor.

4.8. Field Engineering Service

4.8.1. Contractor shall include in his quotation the services of a field-service engineer to start-up equipment after engines have been shaken down. Services shall be provided for a minimum of 20 working days. After this time, if services are still required, they shall be paid by the government at standard per diem rates, if the delay is caused by the government or other contractors. Contractors shall furnish necessary equipment so that engines can be checked out and operated for shake down without necessity of control equipment engineer standing by or in the event a control engineer is required, cost shall be paid by the control manufacturer.

4.8.2. Included in the 20 day time above shall be a maximum of 5 days for instruction and familiarization of governments personnel.

4.8.3. Provide 3 completely detailed written operating instructions and trouble shooting manuals to governments' representative.

CHAPTER IV

MAJOR SYSTEMS SPECIFICATIONS

INDEX

SEC. 1.0 ELECTRICAL SPECIFICATIONS

1.1. Transformer Specification

1.1.1. This specification is for a station type, outdoor, weatherproof, step-up transformer.

1.1.2. The ratings of the transformer are as follows:

1.1.2.1 High voltage side - output side

KVA: 1000

High Voltage: 12.47 KV

Connections: Wye

Taps: Four 2½" taps. Taps changed under no load conditions. Two taps above and two below nominal voltage with provision for locking in each position.

BIL: 95 KV

Phase: 3 ø, 4W

Frequency: 60 Hz.

1.1.2.2. Low Voltage side - input side

Low Voltage: 480V

Connections: Wye

Phase: 3ø, 4W

Frequency: 60 Hz.

BIL: 30 KV

1.1.3. General

1.1.3.1. The unit will be liquid immersed in a non-flammable liquid.

1.1.3.2. Temperature rise will be 65°C when unit is self-cooled. Provision will be made to incorporate fans at a future date. With fans operating the unit shall be capable of 15% overload without exceeding 65°C temperature rise. Ambient temperature will be 30°C.

1.1.3.3. Nominal impedance will be 5.75%.

1.1.3.4. Provide lifting hooks for entire unit and loops for tank cover.

1.1.3.5. Provide provisions for jacking.

1.1.3.6. Unit will be undercoated and primed with a rust resistant primer and painted with a gray enamel suitable for outdoors, ASA Color #24.

1.1.3.7. Oil tank shall be sealed. Normal tank pressure will be under 10 psig. Pressure gauge, oil temperature gauge, oil level gauge and pressure relief device will be supplied.

1.1.3.8. A hand operated tap changer will be provided. The tap changer is intended for operation when the transformer is not energized. Provision will be made for padlocking the operating mechanism in any position.

1.1.3.9. Provision will be made for the future installation of current transformers inside the main case. A cover opening will be supplied large enough to permit admittance of bushing type current transformers.

1.1.3.10. High and low voltage cables are to be brought through conduit connection type of terminals into an air filled housing which will be mounted on the wall of the transformer case. The cables will enter vertically into the bottom of the chamber.

1.1.3.11. Provision will be made for a 15 KV substation type lightning arrester.

1.1.3.12. Average sound level should not exceed 58 db.

1.1.4. Documentation:

1.1.4.1. A complete set of reproducible outline drawings shall be supplied. The drawings shall include, but not be limited to, overall dimensions, total weight, volume of liquid, recommended mounting methods, recommended pad size, and location of high and low voltage bushings.

1.1.5. Standards

The unit shall be designed, manufactured and tested in accordance with all applicable NEMA, ANSI and IEEE standards.

1.1.6. Short Circuit Bracing:

The unit shall be braced to withstand the maximum short circuit current available from the transformer.

1.1.7. Items not mentioned but obviously necessary for proper operation are implied in this specification.

SPEC. 1.0. ELECTRICAL SPECIFICATIONS

1.2. 600 AND 750 KVA TRANSFORMER AND DISCONNECT SWITCH

1.2.1. This specification is for a station type, outdoor, weatherproof, tamper-resistant 500 KVA transformer and a fused disconnect switch (on low voltage side).

1.2.2. Transformer Ratings

1.2.2.1. High voltage side

KVA: 500

High Voltage: 12.47 KV

Connections: Wye

Taps: Four 2½% taps, two above and two below nominal. Taps changed under no load conditions and shall have provision for being locked in position.

BIL: 95 KV

Phase: 3Ø, 4W

Frequency: 60 Hz.

1.2.2.2. Low Voltage side

Low Voltage: 480V

Connections: Wye

Phase: 3Ø, 4W

Frequency: 60 Hz.

BIL: 30 KV

1.2.2.3. The transformer will be liquid immersed in a non-flammable liquid.

1.2.2.4. Temperature rise will be 65°C in a 30°C ambient. Provision will be made to incorporate fans at a future date. With fans operating the unit shall be capable of a 15% overload without exceeding the 65°C temperature rise.

1.2.2.5. Nominal impedance shall be 5%.

1.2.2.6. Oil tank to be sealed. Tank pressure will be under 10 psig. Pressure gauge, oil temperature gauge, oil level gauge, and pressure relief device will be supplied.

1.2.2.7. High and low voltage cables are to be brought through conduit connection type of terminals into an air filled housing which will be mounted on the wall of the transformer case. The high voltage cables will enter vertically into the bottom of the chamber and the low voltage cables will enter into the top of the chamber.

1.2.3. General

1.2.3.1. The transformer shall be braced by structural steel members, to form a rigid frame which will not twist during movement. The unit will be so constructed as to allow sliding or movement on rollers in any direction and shall have provision for jacking.

1.2.3.2. A prominent nameplate indicating equipment ratings, tap changing information, manufacturer's name and serial number will be mounted in the front of the unit or in an easily accessible area.

1.2.3.3. Lifting hooks will be provided for the entire unit and individual shipping sections, if any.

1.2.3.4. The unit will be undercoated and primed with a rust resistant primer and painted with a gray, outdoor enamel, ASA Color #24.

1.2.3.5. Average sound level should not exceed 56 db.

1.2.3.6. Provision shall be made for addition of CT's at a future date.

1.2.3.7. Provision shall be made for a 15 KV station type lightning arrester.

1.2.4. Fused Disconnect Switch

1.2.4.1. The fused disconnect switch shall be a 480 V, 600 A, 3 ∅, SN unit. Impulse withstand shall be 30 KV. The enclosure will be drip-proof. Opening will be screened to prevent entrance of vermin and barriered to inhibit entrance of snow and sand. A 480 V space heater shall be provided in the unit.

1.2.4.2. The fused disconnect shall be quick make - quick break type. The unit will have provision for being locked in the off position. The door will be interlocked with the handle to prevent opening with the handle in the "on" position. The interlock will be constructed so that it can be released with a standard electrician's tool for testing fuses without interrupting service.

1.2.4.3. All bushing and connections shall be braced to withstand the maximum short circuit current available from the transformer.

1.2.4.4. The unit will be undercoated and primed with a rust resistant prime and painted with a gray, outdoor enamel, ASA color #24.

1.2.5. Both assemblies shall be designed, manufactured, and tested in accordance with all applicable NEMA, ANSI and IEEE standards.

1.2.6. Documentation

1.2.6.1. A complete set of reproducible drawings shall be supplied for both assemblies. The drawings shall include, but not be limited to, overall dimensions, total weight, volume of transformer liquid, recommended mounting methods, recommended pad size, conduit entrance area and location of high and low voltage bushings, wiring diagrams and schematics.

1.2.7. Items not mentioned but obviously necessary for proper operation are implied in this specification.

1.0. ELECTRICAL SPECIFICATIONS

1.3. Unit Substation

1.3.1. This specification is for a pad mounted, outdoor, weatherproof, tamper-resistant, aisleless substation, consisting of a transformer, transition section (if required), an auxiliary section, a main draw out metal clad circuit breaker, four draw out metal clad feeder circuit breakers and two fixed circuit breakers.

1.3.2. Transformer Section

1.3.2.1. Ratings

High voltage side.

KVA: 3750

High Voltage: 22.9 KV

Connections: Delta

BIL: 150 KV

Taps: Four 2½% taps. Two above and two below nominal.

Phase: 3 ø

Frequency: 60 Hz.

b. Low voltage side.

Low Voltage: 12.47 KV

Connections: Wye

Phase: 3ø, 4W

Frequency: 60 Hz.

BIL: 110 KV

1.3.2.2. The transformer will be liquid immersed in a non-flammable liquid.

1.3.2.3. Temperature rise will be 55°C. Provision will be made to incorporate fans at a future date. With fans operating the transformer shall be capable of a 10% continuous overload without exceeding the 55°C rise.

1.3.2.4. Nominal Impedance will be 5%.

1.3.2.5. The oil tank will be sealed. A sudden pressure relay (24 VDC), pressure gauge, oil temperature gauge, oil level gauge will be supplied. The sudden pressure relay will operate a warning light on the door of the auxiliary section.

1.3.3. Transition Section

1.3.3.1. A transition section may be used, if required.

1.3.4. Auxiliary Section

1.3.4.1. The auxiliary section will include all metering and a station service transformer as shown on the single line. Metering shall be semi-flush mounted on a hinged door.

1.3.4.2. A 12 cell (or larger) lead-calcium storage battery, with a suitable 24 VDC charger, of suitable capacity to supply tripping and closing functions for the outgoing section power circuit breakers.

1.3.5. Main Breaker Section

1.3.5.1. The main breaker will be a drawout type rated for 3ø, 60 Hz., 13.8 KV, 1200 A and 500 MVA Class.

1.3.6. Outgoing Breaker Section

1.3.5.1. There will be four drawout type breakers rated for 3ø, 60 Hz., 1200 A, 13.8 KV and 500 MVA Class. Trip will be 24 VDC. Relay and C.T. arrangement will be as shown on single line.

1.3.5.2. There will be two air circuit breakers rated for 3∅, 60 Hz., 1200 A, 13.8 KV, and 500 MVA. These breakers will be arranged so that one is normally closed and the other normally open. Upon loss of voltage at the normally closed breaker, it will trip and in so doing close (or cause to be closed) the normally open breaker. When voltage is restored, the breakers will be capable of being manually reset to their original N.O. and N.C. positions. They will be interlocked so that they both cannot be in the closed position and the N.C. breaker will open before the N.O. breaker closes.

1.3.5.3. All conduit will exit from below the respective breaker compartments. The conductors will be #6 AWG, 15 KV cable.

1.3.6 <u>General</u>

1.3.6.1 The substation may consist of two or more sections consistent with good shipping practice. Each section will be made of structural steel members, welded to form a rigid frame which will not twist during movement. When the shipping sections (if any) are bolted together, the entire assembly shall be a rigid structure.

The unit will be constructed as to allow sliding or movement on rollers in any direction and shall have provision for packing.

1.3.6.2. A prominent nameplate indicating equipment ratings, tap changing information, manufacturer's name and serial number, will be mounted in an easily accessible area away from any dangerous voltage.

1.3.6.3. Lifting hooks will be provided for each shipping section. The transformer, even if part of another shipping section, shall have lifting hooks.

1.3.6.4. All compartments will have heaters and lights. Heaters will be sized to allow operation in any populated area of the Continental U.S. Lights and heaters will be operated from the station service transformer. The KVA of this transformer may be increased, if required, allowing a minimum of 5 KVA for station service.

1.3.6.5. The unit will be undercoated, primed with a rust inhibiting primer and painted with a gray, outdoor enamel, ASA Color #24.

be under 10 psig. Pressure gauge, oil temperature gauge, oil level gauge and pressure relief device will be supplied.

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1.3.6.6. Breakers will be interlocked so that they are tripped when removed from the housing.

1.3.6.7. Breakers will be operated by a stored energy type of mechanism. Primary contacts will be silver plated and supported on porcelain pole units. The primary disconnecting fingers will be silver plated. Arc chutes with center coil blow out magnets will be provided. A barrier in front of the arc chutes will form a shield from primary parts.

Secondary disconnecting contacts will be silver plated.

1.3.7. <u>Documentation</u>

1.3.7.1. A complete set of reproducible drawings shall be supplied. The drawings will include, but not be limited to, overall dimensions, total weight, volume of transformer liquid, recommended pad size, recommended mounting methods, conduit entrance area, high and low voltage bushing locations and a complete set of wiring diagrams and schematics.

1.3.8. Items not mentioned but obviously necessary for proper operation are implied in this specification.

SPECIFICATIONS FOR

2.0 SEWAGE DESCRIPTION

2. 1. Process Description

2.1.1 The effluent to be discharged from the sewage treatment plant (STP) is to be a tertiary quality. For the purpose of this specification this is defined as follows:

2.1.1.1

	Monthly Average
BOD_5	10mg/l
Suspended Solids	10mg/l
pH	$>$6 but $<$ 8
Dissolved O_2	$\geq$4 mg/l
Cl_2 Residual	$\geq$1 mg/l

2.1.2 State and local regulations must also be observed. In cases where there is a difference, the more stringent guideline is to be used.

2.1.3 To achieve the specified level of treatment, the incoming raw sewage is clarified. The overflow from the primary clarifier is discharged through a hairpin heat exchanger, where its exit temperature is controlled at 90°F. The heated steam passes to a rotating disc contactor, which provides a secondary level of treatment aerobically. The secondary treated effluent is pumped to the secondary clarifier, and the overflow discharged to tertiary sand or mixed media filters. These filters provide the final polishing step prior to chlorination and discharge.

2.1.4 Sludge is to be thermally treated and used as landfill or soil conditioner. The sludge from the secondary clarifier is returned to the primary clarifier to enhance thickening. The primary claifier sludge is discharged once per day by means of a screw pump, and is heated to 350°F. The sludge is introduced to an autoclave where it is kept at this temperature and pressure for approximately 1 hour. The sludge is then cooled and discharged into a basket centrifuge. The solids from the centrifuge discharge into a hollow shaft screw conveyer, where the sludge is further cooled and discharged into a hopper for removal. The centrate is returned to the front end of the rotating disc contractor, being cooled to 90°F after leaving the centrifuge.

2.1.5 It is anticipated that the Army will, in the future, require a portion of the effluent to be further treated and recycled to the barracks complex for non-potable uses, such as laundry, toilet flushing, etc.

2.2. Equipment Specification

2.2.1 Primary Clarifier

Hydraulic Loading Rate	600 gpd/ft.^{2} max.
Dentention Time	3 hours min.
Anticipated BOD Removal	25%
Anticipated S.S. Removal	45%

2.2.1.1 The clarifier tank shall be of steel constuction, and the manufacturer shall supply and install the following: skimming device and scum through sludge removal device complete with motor drive, and steel bridge complete with handrail and deck plates.

2.2.1.2 The sludge removal mechanism shall be sized to completely remove accumulated sludge once per day.

2.2.2 Rotating Disc Contactor

2.2.2.1 An aerated biological treatment device called a "Rotating Disc Contactor" (RDC) shall be installed in prepared concrete tank by others. The tank shall be dimensioned and baffled in accordance with the manufacturers drawings.

2.2.2.2 The RDC equipment shall include shaft assembly(s), electrical drive system(s) and prefabricated housing(s).

2.2.2.3 Each shaft assembly shall include the high-density polyethylene media, with each sheet integrally welded to a polyethylene hub, and self-supporting on the central shaft; a sprocket, two bearings, and two bearing base plates.

2.2.2.4 The electrical drive system shall be a factory assembled unit which includes motor, speed reducer, multi-V belt drive, belt guard and output socket. Controls shall be provided by others. Motor shall conform to NEMA Design C for torque characteristics, and NEMA Class B for insulation, and should be suitable for high moisture, high humidity service.

2.2.2.5 The prefabricated housing shall consist of vacuum-formed side panels and end panels which shall be field assembled. The material shall be a composite, with outer shell of acrylic material, and

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inner layer of fiberglass. Removable doors shall be provided at each end, and observation ports with covers provided in the sides as directed by the engineer.

2.2.2.6 The RDC equipment shall be sized and arranged to produce an effluent consistent with the final effluent quality of the sewage treatment plant.

2.2.3 Secondary Clarifier

Hydraulic Loading Rate	600 gpd/ft.^{2} max.
Detention Time	3 hours max.

2.2.3.1 The clarifier tank shall be of steel constuction, and equipped with sludge removal equipment to be operated once per day. Sludge to be recycled to primary clarifier. All appurtenances such as sludge removal equipment drive, weirs, baffles, bridge sttel and deck plates to be supplied with clarifier.

2.2.4 Pressure Filters

2.2.4.1 Tandem vertical pressure filters shall be provided for either sand or mixed media filtration. The filters will operate alternately, the cycles being controlled by an automatic multiport valve, initiated by a differential pressure swich. Backwash water will be provided from the finished water storage tanks, which sould be sized to provide sufficient backwash water as specified by the filter manufacturer. The storage tanks overflow to discharge will be controlled by a level controller and control valve.

2.2.5 Chlorine Generator

2.2.5.1 On-site chlorine generation equipment will be supplied to produce sodium hypochlorite from common salt. The equipment shall include brine storage tank, electrolytic cell reactor, hypochlorite storage, and metering pump. The hydrogen produced shall be vented to atmosphere. The equipment shall be sized to provide sufficient chlorination to meet the chlorine demand plus the legally mandated residual at the plant location.

2.2.6 Sludge Conditioning Equipment

2.2.6.1 The sludge from the primary clarifier will be processed once per day. Sludge production should be computed, and the equipment in the sludge train sized accordingly.

2.2.6.2 The sludge preheaters are to be constructed from corrosion resistant materials, and should be

of conventional shell and tube design, sludge being on the tube side. Velocity in the tubes should be sufficient to minimize the possibility of clogging and fouling buildup. The exchangers should be so designed that tube cleaning can be accomplished without interrupting the daily batch processing. Provision should be made for flushing the exchangers with clean water after each processing, with the effluent returning to the primary clarifier.

2.2.6.3 The autoclave should be specified for design conditions of 400°F and 300 psia. Normal operating conditions will be 350°F and 250 psia. The autoclave should be equipped with pressure relief valves, compressed air connection, and a hot fluid jacket. A bottom dump valve should be provided, controlled by a temperature interlock. The conditioned sludge should not be dumped until the temperature has been reduced to 150°F or less.

2.2.6.4 A basket-type centrifuge, operated on compressed air should be provided. The centrifuge should be mounted under the autoclave, and should itself be provided with a bottom dump. Centrate from the equipment should be cooled to 90°F and returned to the front end of the RDC.

2.2.6.5 Solids from the centrifuge are discharged to a hollow shaft screw processor. The screw is to be used as a passage for cooling water, which will reduce the sludge temperature to ambient for removal to the disposal site.

2.2.6.6 All the sludge processing equipment is to be contained within a concrete block enclosure, with remote operating controls. No personnel should be within the enclosure during processing operations.

2.2.6.7 All sludge processing equipment should be flushed with clean water subsequent to the completion of processing, and the flushing returned to the primary clarifier.

3.0. INCINERATOR SPECIFICATION, WASTE HEAT RECOVERY

3.1. Incinerator

3.1.1. The incinerator design will be based on the controlled air principle. It shall have a design capacity of from 1110 to 1600 lbs. per hour of residential, commercial and institutional refuse with an average combined High Heat Value of 6000 Btu/#.

3.1.2. The unit shall be of a standard design, factory assembled, pre-tested, on a structural bedplate, ready for simple bolting together at the site. Inner walls shall be lined with castable monolithic refractory backed by mineral wool insulation. Alloy steel anchors shall be provided to support the refractory material with a safety factor of four and the entire final refractory assembly shall be sufficiently flexible to compensate for expansion and contraction associated with normal operation. The incinerator will be so installed as to provide ready, safe access for personnel to manually clean out underfire airports.

3.1.3. The incinerator shall consist of a primary and a secondary combustion chamber. Primary combustion chamber shall be appropriately sized to accomodate the hourly combustion rate, shall have no metallic grates and shall have ash clean out doors located such that leakage of liquid is prevented. Primary chamber shall be provided with an energy source sufficient to maintain the proper operating temperature under all conditions. Secondary combustion chamber shall provide an energy source and air introduction to raise the temperature and consume partially oxidized gases and particles flowing from the primary chamber.

3.1.4. A mechanical charging system will receive wastes in a hopper and by means of an hydraulic ram will feed wastes into the incinerator. The charging system will be equipped with an interlock such that the hopper can be filled without exposure to the direct flame of the incinerator. The charging system will be equipped with an automatic quench with manual override to extinquish any burning material withdrawn from the furnance to the feed hopper by the ram feeder.

3.1.5. A single push button control shall place the incinerator in operation. Completion of the burn cycle will be initiated by simple push button which starts an adjustable burn down period up to five hours. Seperate control devices shall maintain proper operating temperatures in both the primary and secondary chambers.

3.1.6 The lower chamber will consist of 1/4" H.R. steel lined with 2" mineral wool insulation and 5" thick 2400°F castable refractory, fitted with two forced air, No. 2 Diesel fuel oil-fired burners serving primary and secondary chambers.

3.1.7 The upper chamber will consist of 10 Gauge H.R. steel lined with 1 1/2" mineral wool insulation and 4 1/2" insulating castable refractory capable of operation at 2800°F. This chamber will be fitted with a single forced air, Diesel fuel oil-fired burner.

3.1.8 Electrical power service shall be at 220/440/3/60 and all control wiring at 110/1/3/60. Motors shall be TEFC and control cabinet shall be prewired and mounted on the incinerator, dust tight and waterproof NEMA 4 enclosure. Controls shall include flame failure and programmer, fuel modulation, high temperature protection system, timers and all accessories for a complete and functioning system.

3.2. DUCTWORK AND BREECHING

3.2.1 Necessary ductwork and breeching, internally lined with castable refractory, shall be supplied and installed to convey incinerator flue gases from the incinerator to the waste heat recovery heat transfer surface, as required. This ductwork and breeching will be factory fabricated with lining and shipped in convenient to handle sections for bolting in place at the site.

3.3. DIVERTER DAMPER

3.3.1 A refractory lined guillotine or butterfly diverter damper will be supplied and installed in breeching. In the normally closed position this damper will block the hot incinerator flue gases from going directly to the stack for atmospheric discharge and divert them to the waste heat transfer surface. A controller on the heat transfer medium, steam or hot water, will actuate the motor operator and automatically open this diverter damper when temperature rises above emergency discharge set points.

3.4. CHARGING DOOR

3.4.1 The furnace charging door shall be of a guillotine type and shall be refractory lined and insulated. The door lining shall be lightweight castable refractory, minimum 4" thick, suitable for 2000°F operation, backed with 2" of mineral wool block insulation. The refractory lining

and insulation shall be properly anchored to the reinforced exterior #12 Ga. casing and to the main door frame.

3.4.2 The door shall be hydraulically operated and partially counterweighted. The operating cycle timing shall be compatible with the timing of the ram charging cycle.

3.5. HEAT TRANSFER SURFACE

3.5.1 The heat exchanger shall be designed for a hot water flow of approximately 29 GPM and a temperature rise from approximately 360°F to 400°F when the incinerator-boiler is operating at its full-rated capacity. It shall have a suitably sized heat transfer area with manufacturer specifying fouling factor and need and method for soot flowing. It shall have adequate provision for ash/residue collection at each gas pass.

3.5.2 The incinerator manufacturer shall furnish design parameters pertaining to the following:

a.	gas flow to heat exchanger	CFS @ 1500°F
b.	gas flow from heat exchanger	CFS @ 500°F
c.	gas enthalpy at 1500°F	Btu/#
d.	gas enthalpy at 500°F	Btu/#
e.	gas constant	

3.5.3 The heat exchanger shall be a water-tube type with tubes arranged in an "in line" pattern and spaced so that the gas velocity between the tube rows does not exceed 20 ft/sec.

3.5.4 Tubes shall be of suitable material of construction to prevent corrosion and erosion by the gas stream and shall be designed for 125 psi internal water pressure.

4.0 WASTE HEAT BOILER

4.1. Heat Recovery System

4.1.1 The heat recovery system is essentially a horizontal or a vertical heat recovery silencer arranged to receive hot exhaust gas from the engines, and recapturing heat through a series of water tube heat exchangers.

4.2. Heat Recovery Equipment

4.2.1 The heat recovery section of the waste treatment shall consist of longitudinally plan tubes with surrounding shroud tubes.

4.2.2 The waste heat unit shall be designed to provide maximum economical heat recovery at full engine load while not imposing a pressure loss in excess of the engine manufacturers recommendations.

4.2.3 The top chamber of each unit shall be removable for inspection and cleaning of tubes. The heat recovery unit shall be of water tube construction for minimum warm up time. The wet weight shall not exceed the dry weight by more than 10%.

4.2.4 All units are to be constructed in accordance with the ASME Code for unfired pressure vessels and carry the appropriate stamp. The usual construction for oil operated engines is a welded steel shell with removable ends for cleaning the gas passages and with boiler tubes welded into steel tube sheets.

4.2.5 The waste heat unit shall be designed and fabricated in accordance with ASME Code Sec. VII DIVI for hot water. The maximum water pressure shall not exceed 125 psig at 250°F.

CHAPTER V

CONCEPTUAL DESIGN OF SOLID WASTE MANAGEMENT SYSTEM

CONCEPTUAL DESIGN
OF
SOLID WASTE MANAGEMENT SYSTEM

Incineration with heat recovery has been selected as the method of waste disposal and integration into the (TU) Total Utility Plant for the 1200 EM Barracks Complex. The task is to design a system that makes the most efficient use of the waste material generated in the complex and at the same time reduces the waste disposal's impact on the environment. The equipment selected must also be presently commercially available from several companies to insure competitive price and delivery.

Incineration and heat recovery is a continually changing field. Therefore, emerging technology must be continuously surveyed for rapidly growing improvements that can be beneficially applied to this project.

The initial solid waste data is summarized in Table I, which gives estimates of the expected quantity, by weight, of wastes generated in each of the sixteen buildings which comprise the 1200 man complex. Originally supplied design parameters suggested a single standard value for both the density values and energy (BTU) content for all of these wastes.

Table I, however, presents two sets of data. One is based on the Corps of Engineers furnished figures; the other revises the initial data on the basis of certain generally accepted industry classifications such as type, heat content and density associated with each waste type. The totals in Table I were calculated with and without food service building wastes. This was done to point out the importance of this particular source of waste material and its influence on the overall project.

Based upon a graphical representation of a composite "People Load" Profile at the complex, (Table II), a projected total weight of wastes generated was calculated in order to verify original assumptions.

TABLE I

PROTOTYPE-1200 EM BARRACKS COMPLEX
SOLID WASTE DISPOSAL SYSTEM

BLDG. NO.	OCCUPANCY	LBS. WASTE GENERATED	ORIGINAL DATA FURNISHED			SUGGESTED REVISED DATA (NOTE 1)					
			BTU's AVAILABLE	VOL. @ 90#/YD^3 Ft.^{3}	Yd^3	TYPE	CONT. BTU/#	BTU's AVAILABLE	DENS. #/ft^3	VOLUME Ft^3	Yd^3
1	3 Module Barracks	272	1,632,000	81.6	3.02	2	4300	1,169,000	12	22.7	0.84
2	3 Module Barracks	272	1,632,000	81.6	3.02	2	4300	1,169,000	12	22.7	0.84
3	3 Module Barracks	272	1,632,000	81.6	3.02	2	4300	1,169,000	12	22.7	0.84
4	3 Module Barracks	272	1,632,000	81.6	3.02	2	4300	1,169,000	12	22.7	0.84
5	4 Module Barracks	352	2,112,000	105.6	3.91	2	4300	1,513,600	12	29.3	1.09
6	2 Module Barracks	176	1,056,000	52.8	1.96	2	4300	756,800	12	14.7	0.54
7	Group Dispensary	32	192,000	9.6	0.36	0	8500	272,000	6	5.3	0.20
8	Branch Exchange	400	2,400,000	120.0	4.44	1	6500	2,600,000	6	66.7	2.47
9	3 Co.Admin. & Stor.	140	840,000	42.0	1.56	Paper	6000	840,000	5	28.0	1.04
10	3 Co.Admin. & Stor.	140	840,000	42.0	1.56	Paper	6000	840,000	5	28.0	1.04
11	4 Co.Admin. & Stor.	185	1,110,000	55.5	20.60	Paper	6000	1,110,000	5	37.0	1.37
12	2 Bn. Hq/Class.	120	720,000	36.0	1.33	Paper	6000	720,000	5	24.0	0.89
13	Reg./Brig. Hq.	120	720,000	36.0	1.33	Paper	6000	720,000	5	24.0	0.89
14	Food Service	5400	32,400,000	1620.0	60.00	3	3000	16,200,000	30	180.0	6.67
15	Unit Chapel	40	240,000	12.0	0.44	Paper	6000	72,000	5	8.0	0.30
16	Gym	200	1,200,000	60.0	2.22	2	4300	860,000	12	16.7	0.62
						LBS WASTE GENERATED					
	Totals	8393	50,358,000	2517.9	111.79	8393		31,180,400		552.5	20.48
	Without Food Svce.	2993	17,958,000	897.9	51.79	2993		14,980,400		372.5	13.81

NOTE 1: Type of waste, BTU/lb. and density data based on the publication, "Incineration Standards" by Incineration Institute of America.

TABLE 1

The peak, daily, number of people at 8:00 a.m., Noon and 6:00 p.m. (1800 hours) were assumed as the the number of meals served. Incinerator Institute of America's data listing quantities of waste for typical operations were used to establish a figure of 2 pounds of waste material per meal. In addition, we used a figure of 3 pounds of waste per person for the average number of people in the complex. This procedure gave us a total weight of 8,406 pounds of generated waste correlating very well with the 8,393 pounds presented in the original data. All further calculations were based on the original 8,393 pounds.

Tables III a, b, c and d tabulate the recoverable heat from the Diesel generators and the incinerator, the required heat for heating, cooling and domestic hot water from representative profiles furnished us and the heat required from the boilers. Tabulations are made for five and seven hour burn cycles and for the original and suggested revised data.

The decision as to what hours the incinerator should be operating can be made by reviewing the data in Tables III. For the purposes of this study, we have initially selected burn cycles of 5 and 7 hours (actual incineration). This will require only a single operating shift.

During the winter months the required heat so far exceeds the available that the time or length of burning seems inconsequential.

Under summer conditions, the peak BTU demand occurs between Noon and 7:00 p.m. Burn time can then be established as 12:00 to 5:00 p.m. for a five hour burn or 12:00 to 7:00 p.m. for a seven hour burn. However, this does not preclude shifting the burn time, during the winter months, to get a better match with peak heating demand.

Using the original data for the summer months, it is apparent that a seven hour burn cycle wastes less BTU's than the five hour cycle. The five hour cycle creates an oversupply on 10 of the 15 hours our data covers. The total loss is 11,623 MBH. The seven hour cycle produces excess BTU's 5 of the 21 hours the data covers for a loss of 3,149 MBH.

With the suggested revised data we have a similar, but not so drastic situation. The five hour cycle produces an overage 2 of the 15 hours our data covers for a loss of 751 MBH. The seven hour cycle produces no excess BTU's.

A seven hour burn cycle for winter and summer would therefore seem more appropriate than a five hour cycle. It is assumed that an 8 hour shift would produce a seven hour burn cycle.

The selection of an incinerator must be based on the amount and type of waste to be incinerated. Based on the use of the buildings we can assume that Type 0, 1, 2 and 3 wastes will be incinerated. This type of waste can be handled by a two chamber controlled air type of incinerator. This type of unit is relatively inexpensive, easy to operate and maintain and is available from many existing sources. One of their great cost advantages is that they can meet emission standards without additional exhaust gas cleaning equipment.

The selection of an actual unit is dependent upon the weight and volume of material to be incinerated. The requirements are as follows:

Burn Time	5 hours	7 hours
#/hr burned	1679	1199
ft^3/hr burned (orig. data)	504	360
ft^3/hr burned (revised data)	110	79

Sample data on two incinerator sizes and three different manufacturers' models that would handle the above loads are:

Manufacturer	Capacity ft^3	Capacity #/hr	Proposed Burn Cycle
Manufacturer A_1	550	1520-2100	5 hours
Manufacturer A_2	325	1110-1600	7 hours
Manufacturer B_1	401	1475	7 hours
Manufacturer B_2	625	1950	5 hours
Manufacturer C_1	415	1425	7 hours
Manufacturer C_2	523	1900	5 hours

A small front loader can be used for all material handling after the waste material is dumped into the storage area of the incinerator building. The front loader can be used to move the material around to facilitate storage and to load the material into the incinerator. The same unit can be used to aid in ash removal.

The building size is determined by the garbage storage area required, the size of the incinerator and its loader and the operating area required around the incinerator.

Based on an assumed twice a week pick-up and a waste storage height of 3 feet, the area required for waste storage would be:

$$A = \frac{ft^3 \text{ waste/day} \times 3.5 \text{ days}}{3 \text{ ft.}}$$

A (based on original data) = 2937.6 ft^2

A (based on revised data) = 644.6 ft^2

We can see that it is crucial to have as accurate as possible a figure on waste volume to size the incinerator plant. Field characterization tests are recommended for exact determination.

The width of the building will be determined by the incinerator, operating area around the incinerator and a storage area for bulky waste items awaiting removal. For the purpose of this report, we will assume the length of the incinerator to go across the width of the building.

As an example, the lengths of the two Manufacturer A's models we have assumed are:

Model	Length*	Clearance for Cleanout and Inspection	Total
A_1	24'	6'-6"	30'-6"
A_2	29'	6'-10"	35'-10"

*Includes feeding equipment.

Width of the units are:

Model	Width	Clearance for Cleanout and Inspection	Total
A_1	11'-1"	4'	15'-1"
A_2	12'-1"	4'	16'-1"

Additional room is required at the cleanout end if we are to use the front loader to aid in ash removal, and 10 more feet should be allowed for this. Another eight foot long storage area for large objects should be provided.

Based on the A_1 model the building width required would be 48'-6" (inside dimension). The length would be 16' for the incinerator plus 60'-7" or 13'-4" depending on the storage area required for the original or revised data. Drawing B-SK-1 is a proposed layout of the incinerator building.

Ash removal from the incinerator will be manual and performed daily. Incineration can produce an 80% to 90% reduction in solids.[1] This would represent an ash residue of:

Original data:	503.6 ft^3 or 18.65 yd^3	(See Table I)
Revised data:	110.5 ft^3 or 4.1 yd^3	

This data would suggest ash pick-up for hauling to a disposal area of once a day based on the original data or twice a week based on the suggested revised data. A small front loader could be used (the same one as for material handling) to transfer ash from the ash pit to an ash storage container to await pick-up. It would require two shifts to remove the 503 ft^3 projected by the original data and one shift to remove the 110 ft^3 of the revised data.

(1) MIUS Technical Evaluation
Solid Waste Collection and Disposal
ORNL.

Only one man would be needed to operate and load the incinerator. The same man could remove the ashes from the ash pit if the revised data is used. Based on the original data, a second man (second shift) would be required to continue ash removal.

An eight hour, one man, shift would be as follows:

11:00 a.m.-Noon:	Ash cleanout and start incineration.
Noon-7:00 p.m.:	Continue incineration, remove ashes from ash pit, put equipment in shutdown mode at end of cycle.

If required, the second shift would be for ash removal only.

The amount of heat that can be recovered from the incineration process is tabulated in Table III a, b, c and d. The recoverable MBH was determined by

$$\text{MBH Recoverable} = \frac{\left(\frac{Qa}{B} + F\right) e}{1000} \quad \text{(See Data Sheet IV)}$$

Qa = BTU available in the waste generated.

B = Burn time in hours.

F = BTUH input for primary and secondary chamber auxiliary burning. (Data taken from manufacturer's catalog).

e = Heat recovery efficiency - taken as a conservative 50% for this study. (Depending upon the type of heat recovery equipment selected, this figure can be as high as 65%).

Heat can be recovered and used in several ways. Using an integrated gas to water heat exchanger with the incinerator and assuming a water inlet temperature of 223°F, we could generate approximately 280 GPM of 245°F water or approximately 30 GPM of 420°F water for the thermal storage tank. Another option would be to raise the temperature of the thermal storage tank to account for the temperature drop the tank will see during the time the incinerator plant is not running.

Without using a gas to water heat exchanger, the incinerator flue gas could be introduced directly in one of the hot water heaters which would be modified to operate either as a waste heat, or oil fired hot water heater. This method would utilize the same auxiliary boiler equipment used in conjunction with the prime movers. The above options would eliminate the heat recovery unit at the incinerator.

Any method of heat recovery selected would require a layout of the energy plant to be compatible with the particular scheme selected.

Heat storage for the incinerator system would not seem to be warranted in this study. If we use the suggested revised data, we do not produce more BTU's than can be used for either a 5 or 7 hour burn cycle. If the original data is used, the seven hour burn cycle produces some excess BTU's but its total for any day is not enough to supply the needs of any single high usage hour. The 5 hour burn cycle (original data) produces excess BTU's 66.7% of the time during the summer months. This would be more indicative of a longer burn cycle rather than heat storage.

In terms of fuel savings only, the recoverable heat is equivalent to 45.5 gallons per day of No. 2 Diesel fuel. This takes into account the fuel required for auxiliary burning in the incinerator. In addition to this saving, present hauling and disposal costs of wastes can be reduced by approximately 80 to 90% and spent Diesel lubricating oil reused as fuel in the incinerator burners. As a result, gross savings exceed fuel savings by the latter two items.

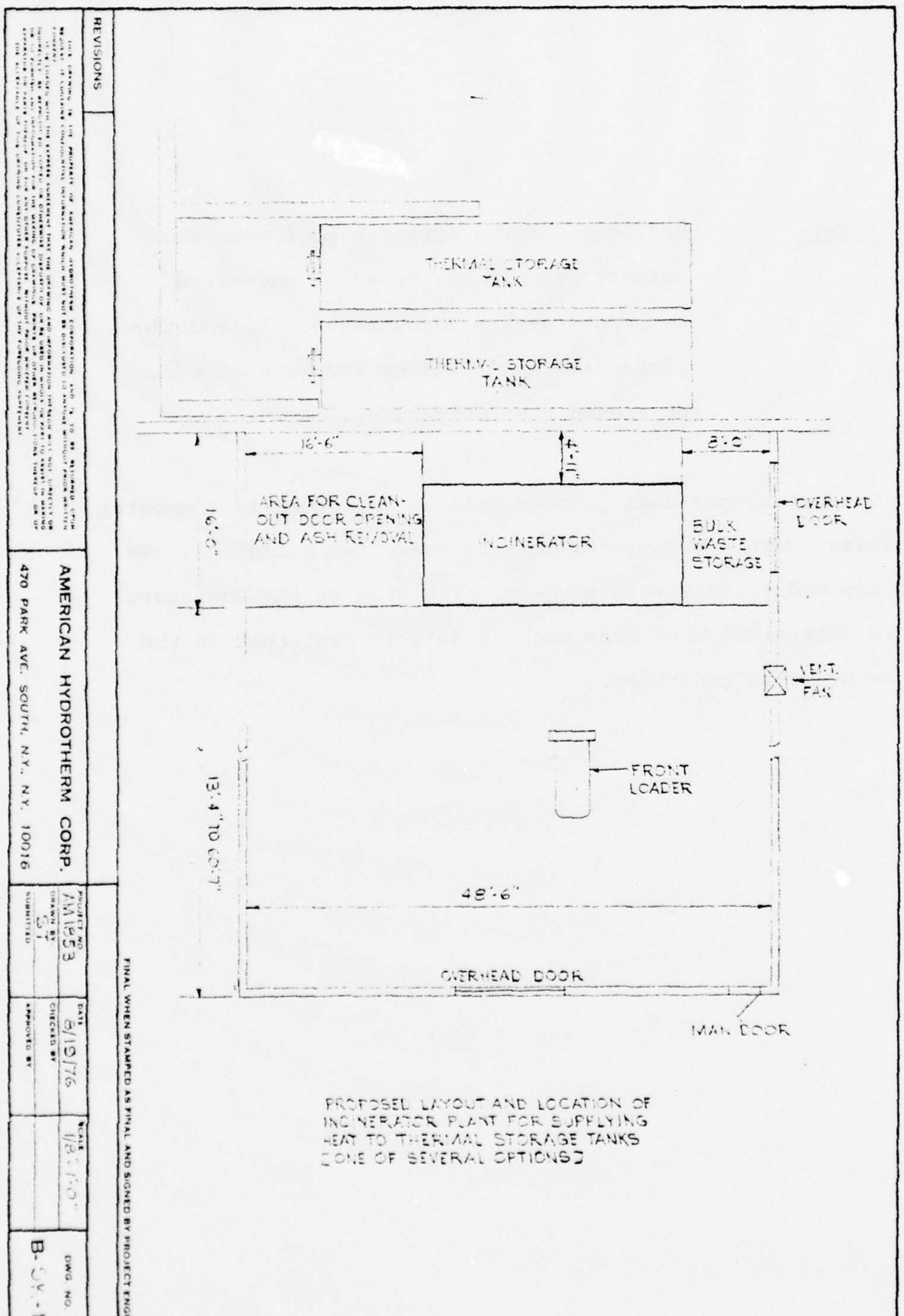
Utility requirements for the system are as follows:

<u>Electrical</u>: 220V, 3 phase, 60 Hz, 50 Amp and 110V, 60 Hz, 20 Amp.

<u>Gas</u>: 6" W.C. natural, 11" W.C. L.P. (can also be supplied with oil burners).

Water: Sufficient for a spray to cool down the primary chamber in the event excessive temperatures are encountered. In addition, a standard hose fitting for general clean-up around the incinerator.

This study presumes garbage will be collected in "Dempster Dumpsters" with one Dumpster serving every two buildings. We have assumed twice a week pick-up. The size of the Dumpsters can be determined when more precise data is available on the volume of waste generated.



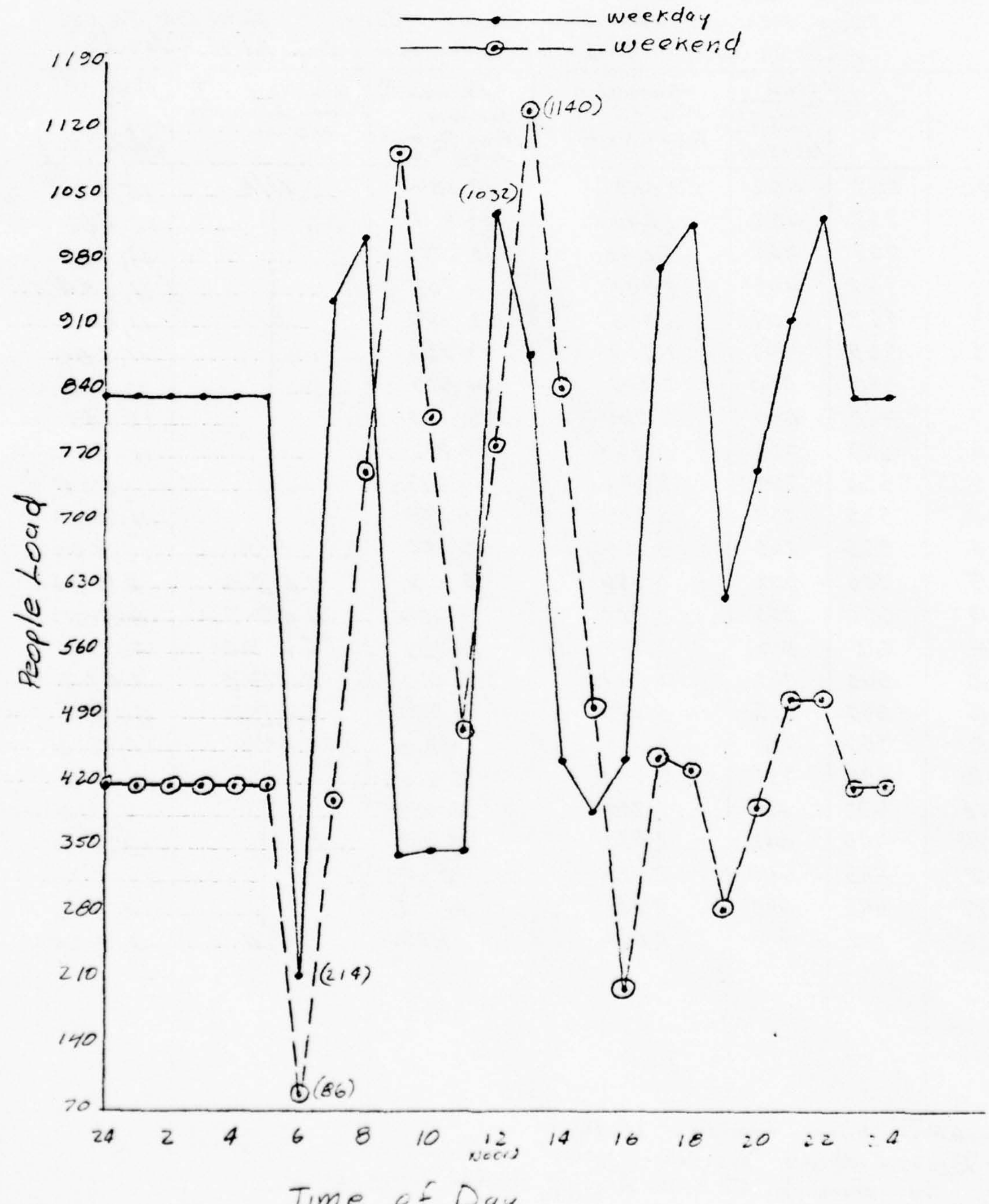
PROPOSED LAYOUT AND LOCATION OF INCINERATOR PLANT FOR SUPPLYING HEAT TO THERMAL STORAGE TANKS [ONE OF SEVERAL OPTIONS]

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ____ DATE ____ SUBJECT *Profile of People Load - Total - @ 1200 Elms Complex - Ft Belvoir* SHEET NO. *1* OF *1*

CHKD. BY ____ DATE ____ JOB NO. *AM 1853*

Data Sheet II



AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY [illegible] DATE 7/16/76 SUBJECT Ft. BELVOIR SHEET NO. 1 OF 6

CHKD. BY ______ DATE ______ HEAT RECOVERY CALCS JOB NO. AM 253

Data Set IIIa WINTER January 22

Reference: G-K-C BASE ELECTRIC PROFILE - COMPOSITE, PEAK CONDITIONS FROM WEATHERTAPE 1545 + DATA. COMPOSITE DATA FOR JAN. 22 to JAN. 23. PROFILE DATED 7-15-76 & Heating Profile Comp. Jan 22.

Hour	KW LOAD Electric Only	KW LOAD Total, incl. parasitic (El. + 200)	Recoverable MBTUH Total KW x 4	Required # MBTUH (From Composite dated 7-15)	Available + from Incinerator MBTUH	Required from [illegible] Boiler Source MBTUH
24	262	462	1,848	17,184	N/A	15,336
1	262	462	1,848	14,314		12,466
2	262	462	1,848	13,275		11,427
3	262	462	1,848	13,202		11,354
4	262	462	1,848	13,450		11,602
5	295	495	1,980	13,560		11,580
6	350	550	2,200	14,910		12,710
7	440	640	2,560	14,700		12,140
8	625	825	3,300	14,250		10,950
9	550	750	3,000	14,625		11,625
10	535	735	2,940	14,900		11,960
11	565	765	3,060	15,650	N/A	12,590
12	709	902	3,636	15,125	4493	6996
13	650	850	3,400	14,400	4493	6507
14	610	810	3,240	14,750	4493	7017
15	560	760	3,040	14,950	4493	7417
16	635	835	3,340	14,500	4493	6667
17	550	750	3,000	15,200	N/A	12,200
18	535	735	2,940	16,600		13,660
19	495	695	2,780	16,950		14,170
20	445	645	2,580	15,850		13,270
21	445	645	2,580	15,350		12,770
22	445	645	2,580	16,917		14,337
23	315	515	2,060	17,050	N/A	14,990

\+ 5 Hour burn - Revised data

\# Required MBTUH Load Column includes Domestic Hot Water Requirements taken from Jan 22 to 23 Industrial Process Profile Composite

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ________ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 2 OF 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM-1553

Data Set IIa Jan. 23

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load Elec. only	KW Load Total incl. parasitic Elec + 200	Recoverable MBH Total KW × 4	Tons of Adsorp. Refrig.	Required MBH (Total) Cooling/Heat. + DHW	Available MBH from Incinerator +	Required MBH from Boiler
24	262	462	1848	N/A	17,050	N/A	15,202
1	262	462	1848		17,075		15,227
2	262	462	1848		15,675		13,827
3	262	462	1848		15,502		13,654
4	262	462	1848		15,755		13,907
5	295	495	1980		16,110		14,130
6	350	550	2200		17,509		15,309
7	440	640	2560		17,190		14,630
8	625	825	3300		16,800		13,500
9	550	750	3000		16,725		13,725
10	535	735	2940		16,075		13,135
11	565	765	3060		16,450	N/A	13,390
12	709	902	3636		15,250	4,493	7,121
13	650	850	3400		14,280	4,493	6,387
14	610	810	3240		14,450	4,493	6,717
15	560	760	3040		14,260	4,493	6,727
16	635	835	3340		14,100	4,493	6,267
17	550	750	3000		14,555	N/A	11,555
18	535	735	2940		16,120		13,180
19	495	695	2780		16,075		13,295
20	445	645	2580		15,285		12,705
21	445	645	2580		15,010		12,430
22	445	645	2580		16,567		13,987
23	315	515	2060		16,150	N/A	14,090

\+ 5 Hour burn - Revised data

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ______ DATE ______ SUBJECT FT. BELVOIR SHEET NO. 3 OF 6
CHKD. BY ______ DATE ______ HEAT RECOVERY CALCULATIONS JOB NO. AM1853
Data Set II-a JANUARY 24

REFERENCES by G.K.C. Inc

1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Domestic Hot Water Profile " " " " "
(Indirect Process Profile Composite)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elec + 193	Recoverable MBH Total KW x 4	Required MBH (total) Heating + DHW	Available MBH from Inciner. +	Required MBH from Boiler
24	258	451	1,804	16,060	N/A	14,256
1	258	451	1,804	14,982		13,178
2	258	451	1,804	13,768		11,964
3	258	451	1,804	13,536		11,732
4	258	451	1,804	13,536		11,732
5	258	451	1,804	13,536		11,732
6	270	463	1,852	14,375		12,523
7	375	568	2,272	13,980		11,708
8	620	813	3,252	13,425		10,173
9	625	818	3,272	13,300		10,028
10	600	793	3,172	12,925		9,753
11	648	841	3,364	12,800	N/A	9,436
12	645	838	3,352	11,955	4,493	4,110
13	550	743	2,972	11,192	4,493	3,727
14	451	644	2,576	11,210	4,493	4,141
15	451	644	2,576	11,450	4,493	4,471
16	465	658	2,632	11,351	4,493	4,226
17	440	633	2,532	11,770	N/A	9,238
18	475	668	2,672	12,550		9,878
19	450	643	2,572	12,550		9,978
20	410	603	2,412	12,125		9,713
21	410	603	2,412	11,950		9,538
22	350	543	2,172	12,700		10,528
23	300	493	1,972	12,875	N/A	10,903

+ 5 Hour burn - Revised data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ___ DATE 7/27/76 SUBJECT Ft. BELVOIR SHEET NO. 4 OF 6

CHKD. BY ___ DATE ___ HEAT RECOVERY CALCULATIONS JOB NO. AM 1253

Data Set III a AUGUST 19

REFERENCES. by G. K. S., Inc.
1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile " " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from same Weather Tape)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elect + 447	Recoverable MBH Total KW times 4	Tons of Absorp. Refrig.	Required MBH (total) Cooling + DHW	Available + MBH from Incinerator	Required MBH from Boiler
24	262	709	2,836	42	3,490	N/A	654
1	262	709	2,836	42	3,465	|	629
2	262	709	2,836	42	1,965	|	0
3	262	709	2,836	27	1,292	|	0
4	262	709	2,836	27	1,295	|	0
5	295	742	2,968	42	1,600	|	0
6	350	797	3,188	22	2,242	|	0
7	440	887	3,548	90	3,482	|	0
8	625	1,072	4,288	232	5,444	|	1,156
9	550	997	3,988	322	7,106	|	3,118
10	535	982	3,928	361	7,879	|	3,951
11	565	1,012	4,048	407	9,713	N/A	5,665
12	709	1,157	4,628	457	11,391	4,493	2,270
13	650	1,097	4,388	510 ①	11,[illegible]	4,493	2,229
14	610	1,057	4,228	510 ①	11,630	4,493	2,909
15	560	1,007	4,028	510 ①	11,580	4,493	3,059
16	635	1,082	4,328	510 ①	11,430	4,493	2,609
17	550	997	3,988	510 ①	11,360	N/A	7,372
18	535	982	3,928	507	12,496	|	8,568
19	495	942	3,768	361	9,704	|	5,936
20	445	892	3,568	252	6,584	|	3,016
21	445	892	3,568	217	5,549	|	1,981
22	445	892	3,566	207	7,036	|	3,468
23	315	762	3,048	185	6,095	N/A	3,047

+ 5 Hour burn - Revised data

① Cooling Profile Composite Loads for these hours exceed installed capacity. Therefore maximum capacity of absorption machine was used.

SP 100571

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ________ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 5 OF 6
CHKD. BY ________ DATE ________ Heat Recovery Calculations JOB NO. AM 1853
Data Set III a Aug 20

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load: Elec only	KW Load: Total incl. parasitic Elect. +447	Recoverable MBH Total KW times 4	Tons of Adsorp. Refrig.	Required MBH (Total) cooling/Htg + DHW	Available MBH from Incinerator +	Required MBH from Boiler
24	262	709	2,836	157	5,319	N/A	2,483
1	262	709	2,836	157	5,319		2,483
2	262	709	2,836	131	3,588		752
3	262	709	2,836	136	3,309		473
4	262	709	2,836	122	3,054		218
5	295	742	2,968	99	2,636		0
6	350	797	3,188	107	3,842		654
7	440	887	3,548	174	4,783		1,235
8	625	1,072	4,288	278	6,254		1,966
9	550	997	3,988	330	7,268		3,280
10	535	982	3,928	351	7,652		3,724
11	565	1,012	4,048	361	8,864	N/A	4,816
12	709	1,157	4,628	445	10,457	4,493	1,338
13	650	1,087	4,388	403	9,043	4,493	162
14	610	1,057	4,228	432	10,226	4,493	1,505
15	560	1,007	4,028	434	10,252	4,493	1,731
16	635	1,082	4,328	463	10,564	4,493	1,763
17	550	997	3,988	324	7,710	N/A	3,72[illegible]
18	535	982	3,928	278	8,124		4,196
19	495	942	3,768	199	6,633		3,065
20	445	892	3,568	118	4,548		980
21	445	892	3,568	122	4,159		591
22	445	892	3,568	122	5,811		2,243
23	315	762	3,048	82	4,590	N/A	1,542

+ 5 Hour burn - Revised data

SF 10092A

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY __________ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 6 OF 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM 1853

Data Set III a Aug 21

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load: Elect. only	KW Load: Total incl. parasitic Elect. + 447	Recoverable MBH Total KW times 4	Tons of Adsorp. Refrig	Required MBH (total) cooling/heat. + D.H.W.	Available MBH from Incinerator +	Required MBH from Boiler	
24	258	705	2820	70	4060	N/A	1,240	
1	258	705	2820	40	2150		0	
2	258	705	2820	36	856		0	
3	258	705	2820	3	196		0	
4	258	705	2820	-8	136		0	
5	258	705	2820	-9	136		0	
6	265	712	2848	-10	850		0	
7	370	817	3268	80	2450		0	
8	665	1112	4448	128	1501		0	
9	625	1072	4288	215	4955		667	
10	600	1047	4188	324	7780		3,592	
11	648	1095	4380	332	7427	N/A	3,047	
12	635	1082	4328	378	8503	4,493	0	318 MBH Excess
13	560	1007	4028	407	8088	4,493	0	433 " "
14	460	907	3628	415	8479	4,493	358	
15	465	912	3648	411	8634	4,493	493	
16	475	922	3688	437	9141	4,493	960	
17	435	882	3528	382	8098	N/A	4,570	
18	475	922	3688	315	6987		3,299	
19	450	897	3588	160	4270		682	
20	420	867	3468	70	2500		0	
21	420	867	3468	49	1980		0	
22	355	802	3208	35	2350		0	
23	300	747	2988	-3	1400	N/A	0	

+ 5 Hour burn - Revised data

SP 100276

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ___ DATE 7/16/76 SUBJECT Ft. BELVOIR SHEET NO. 1 OF 6
CHKD. BY ___ DATE ___ HEAT RECOVERY CALCS JOB NO. A141853
Data Set III b WINTER, January 22

Reference: G-K-C BASE ELECTRIC PROFILE - COMPOSITE. PEAK CONDITIONS FROM WEATHERTAPE 15454 DATA. COMPOSITE DATA FOR JAN. 22 to JAN. 23.
PROFILE DATED 7-15-76 & Heating Profile Comp. Jan 22.

Hour	KW LOAD Electric Only	KW LOAD Total, incl. parasitic (El. + 200)	Recoverable MBTUH Total KW x 4	Required * MBTUH (From Composite dated 7-15)	Available + from Incinerator MBTUH	Required from additional Boiler Source MBH
24	262	462	1,848	17,184	N/A	15,336
1	262	462	1,848	14,314	N/A	12,466
2	262	462	1,848	13,275	N/A	11,427
3	262	462	1,848	13,202	N/A	11,354
4	262	462	1,848	13,450	N/A	11,602
5	295	495	1,980	13,560	N/A	11,580
6	350	550	2,200	14,910	N/A	12,710
7	440	640	2,560	14,700	N/A	12,140
8	625	825	3,300	14,250	N/A	10,950
9	550	750	3,000	14,625	N/A	11,625
10	535	735	2,940	14,900	N/A	11,960
11	565	765	3,060	15,650	N/A	12,590
12	709	902	3,636	15,125	3,177	8,312
13	650	850	3,400	14,400	3,177	7,823
14	610	810	3,240	14,750	3,177	8,333
15	560	760	3,040	14,950	3,177	8,733
16	635	835	3,340	14,500	3,177	7,983
17	550	750	3,000	15,200	3,177	9,023
18	535	735	2,940	16,600	3,177	10,483
19	495	695	2,780	16,950	N/A	14,170
20	445	645	2,580	15,850	N/A	13,270
21	445	645	2,580	15,350	N/A	12,770
22	445	645	2,580	16,917	N/A	14,337
23	315	515	2,060	17,050	N/A	14,990

+ 7 Hour burn - Revised Data.
* Required MBTUH Load Column includes Domestic Hot Water Requirements taken from Jan 22 to 23 Indirect Process Profile Composite

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 2 OF 6
CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM1853
Data Set III b Jan. 23

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data.

Hour	KW Load Elec. only	KW Load Total incl. parasitic Elec + 200	Recoverable MBH Total KW × 4	Tons of Adsorp. Refrig	Required MBH (Total) Cooling/Heat. + DHW	Available MBH from Incinerator +	Required MBH from Boiler
24	262	462	1848	N/A	17,050	N/A	15,202
1	262	462	1848		17,075		15,227
2	262	462	1848		15,675		13,827
3	262	462	1848		15,502		13,654
4	262	462	1848		15,755		13,907
5	295	495	1980		16,110		14,130
6	350	550	2200		17,509		15,309
7	440	640	2560		17,190		14,630
8	625	825	3300		16,800		13,500
9	550	750	3000		16,725		13,725
10	535	735	2940		16,075		13,135
11	565	765	3060		16,450	N/A	13,390
12	709	902	3636		15,250	3,177	8,437
13	650	850	3400		14,280	3,177	7,703
14	610	810	3240		14,450	3,177	8,033
15	560	760	3040		14,260	3,177	8,043
16	635	835	3340		14,100	3,177	7,583
17	550	750	3000		14,555	3,177	8,378
18	535	735	2940		16,120	3,177	10,003
19	495	695	2780		16,075	N/A	13,295
20	445	645	2580		15,285		12,705
21	445	645	2580		15,010		12,430
22	445	645	2580		16,567		13,987
23	315	515	2060		16,150	N/A	14,090

+ 7 Hour burn - Revised Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ____ DATE ____ SUBJECT FT. BELVOIR SHEET NO. 3 OF 6

CHKD. BY ____ DATE ____ HEAT RECOVERY CALCULATIONS JOB NO. AM1853

Data Set II b JANUARY 24

REFERENCES by G.K.C. Inc

1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Domestic Hot Water Profile " " " " "
   (Indirect Process Profile Composite)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elec + 193	Recoverable MBH Total KW x 4	Required MBH (total) Heating + DHW	Available MBH from + Inciner.	Required MBH from Boiler
24	258	451	1,804	16,060	N/A	14,256
1	258	451	1,804	14,932		13,178
2	258	451	1,804	13,768		11,964
3	258	451	1,804	13,536		11,732
4	258	451	1,804	13,536		11,732
5	258	451	1,804	13,536		11,732
6	270	463	1,852	14,375		12,523
7	375	568	2,272	13,980		11,708
8	620	813	3,252	13,425		10,173
9	625	818	3,272	13,300		10,028
10	600	793	3,172	12,925		9,753
11	648	841	3,364	12,800	N/A	9,436
12	645	838	3,352	11,955	3,177	5,426
13	550	743	2,972	11,192	3,177	5,043
14	451	644	2,576	11,210	3,177	5,457
15	451	644	2,576	11,450	3,177	5,737
16	465	658	2,632	11,351	3,177	5,542
17	440	633	2,532	11,770	3,177	6,061
18	475	668	2,672	12,550	3,177	6,701
19	450	643	2,572	12,550	N/A	9,978
20	410	603	2,412	12,125		9,713
21	410	603	2,412	11,950		9,538
22	350	543	2,172	12,700		10,528
23	300	493	1,972	12,875	N/A	10,903

+ 7 Hour burn - Revised Data

SP 100974

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY [illegible] DATE 7/27/76 SUBJECT FT. BELVOIR SHEET NO. 4 OF 6

CHKD. BY ______ DATE ______ HEAT RECOVERY CALCULATIONS JOB NO. AM 1853

Data Set III b AUGUST 19

REFERENCES. 1. Electric Profile Composite from Weather Tape 15454 Data
by G. K. C., Inc. 2. Cooling Profile " " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from same Weather Tape)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elect + 447	Recoverable MBH Total KW times 4	Tons of Absorp Refrig.	Required MBH (total) Cool'g + DHW	Available+ MBH from Incinerator	Required MBH from Boiler
24	262	709	2,836	42	3,490	N/A	654
1	262	709	2,836	42	3,465		629
2	262	709	2,836	42	1,965		0
3	262	709	2,836	27	1,292		0
4	262	709	2,836	27	1,295		0
5	295	742	2,968	42	1,600		0
6	350	797	3,188	22	2,242		0
7	440	887	3,548	90	3,482		0
8	625	1,072	4,288	232	5,444		1,156
9	550	997	3,988	322	7,106		3,118
10	535	982	3,928	361	7,879		3,951
11	565	1,012	4,048	407	9,713	N/A	5,665
12	709	1,157	4,628	487	11,391	3,177	3,586
13	650	1,097	4,388	510 (1)	11,110	3,177	3,545
14	610	1,057	4,228	510 (1)	11,630	3,177	4,225
15	560	1,007	4,028	510 (1)	11,580	3,177	4,375
16	635	1,082	4,328	510 (1)	11,430	3,177	3,925
17	550	997	3,988	510 (1)	11,360	3,177	4,195
18	535	982	3,928	507	12,496	3,177	5,391
19	495	942	3,768	361	9,704	N/A	5,936
20	445	892	3,568	252	6,584		3,016
21	445	892	3,568	217	5,549		1,981
22	445	892	3,568	207	7,036		3,468
23	315	762	3,048	185	6,095	N/A	3,047

(1) Cooling Profile Composite Loads for these hours exceed installed capacity. Therefore maximum capacity of absorption machine was used.

+ 7 Hour burn - Revised Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ____ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 5 OF 6

CHKD. BY ____ DATE ____ Heat Recovery Calculations JOB NO. AM 1853

Data Set III b Aug 20

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load Elec Only	KW Load Total incl. Parasitic Elect. 447	Recoverable MBH Total KW times 4	Tons of Adsorp. Refrig	Required MBH (Total) cooling/Htg + DHW	Available[+] MBH from Incinerator	Required MBH from Boiler
24	262	709	2,836	157	5,319	N/A	2,483
1	262	709	2,836	157	5,319		2,483
2	262	709	2,836	131	3,588		752
3	262	709	2,836	136	3,309		473
4	262	709	2,836	122	3054		218
5	295	742	2,968	99	2,636		0
6	350	797	3,188	107	3,842		654
7	440	887	3,548	174	4783		1,235
8	625	1,072	4,288	278	6,254		1,966
9	550	997	3,988	330	7,268		3,280
10	535	982	3,928	351	7,652		3,724
11	565	1,012	4,048	361	8,864	N/A	4,816
12	709	1,157	4,628	445	10,457	3,177	2,652
13	650	1,087	4,388	403	9,043	3,177	1,478
14	610	1,057	4,228	432	10,226	3,177	2,821
15	560	1,007	4,028	434	10,252	3,177	3,047
16	635	1,082	4,328	463	10,584	3,177	3,079
17	550	997	3,988	324	7,710	3,177	545
18	535	982	3,928	278	8,124	3,177	1,019
19	495	942	3,768	199	6,633	N/A	3,065
20	445	892	3,568	118	4,546		980
21	445	892	3,568	122	4,159		591
22	445	892	3,568	122	5,811		2,243
23	315	762	3,048	82	4,590	N/A	1,542

+ 7 Hour burn - Revised Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 6 of 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. A[illegible]

Data Set III b Aug 21

Ref.: 1. Electric Profile Composite from Weather Tape 15454 D[illegible]
2. Cooling Profile Composite " " " "
3. Indirect Process Profile Composite (Domestic Hot [illegible]
from Weather Tape 15454 Data

Hour	KW Load Elect. only	KW Load Total incl. parasitic Elect.+447	Recoverable MBH Total KW times 4	Tons of Absorp. Refrig.	Required MBH (total) Cooling/Heat. + D.H.W.	Available+ MBH from Incinerator	Required MBH from Boiler
24	258	705	2820	70	4060	N/A	1,240
1	258	705	2820	40	2150		0
2	258	705	2820	36	856		0
3	258	705	2820	3	196		0
4	258	705	2820	-8	136		0
5	258	705	2820	-9	136		0
6	265	712	2848	-10	850		0
7	370	817	3268	80	2450		0
8	665	1112	4448	128	1501		0
9	625	1072	4288	215	4955		667
10	600	1047	4188	324	7780		3,592
11	648	1095	4380	332	7427	N/A	3,047
12	635	1082	4328	378	8503	3,177	998
13	560	1007	4028	407	8088	3,177	883
14	460	907	3628	415	8479	3,177	1,674
15	465	912	3648	411	8634	3,177	1,809
16	475	922	3688	437	9141	3,177	2,276
17	435	882	3528	382	8098	3,177	1,393
18	475	922	3688	315	6987	3,177	256
19	450	897	3588	160	4270	N/A	682
20	420	867	3468	70	2500		0
21	420	867	3468	49	1980		0
22	355	802	3208	35	2350		0
23	300	747	2988	-3	1400	N/A	0

+ 7 Hour burn - Revised Data

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY [illegible] DATE 7/16/76 SUBJECT Ft. BELVOIR SHEET NO. 1 OF 6
CHKD. BY ____ DATE ____ HEAT RECOVERY CALCS. JOB NO. AM1853
Data Set III C WINTER, January 22

Reference: G-K-C BASE ELECTRIC PROFILE - COMPOSITE. PEAK CONDITIONS FROM WEATHERTAPE 15454 DATA. COMPOSITE DATA FOR JAN. 22 to JAN. 23. PROFILE DATED 7-15-76 & Heating Profile Comp. Jan 22.

Hour	KW LOAD Electric Only	KW LOAD Total, incl. parasitic (El. + 200)	Recoverable MBTUH Total KW x 4	Required * MBTUH (From Composite dated 7-15)	Available + from Incinerator MBTUH	Required from additional Boiler Source MBH
24	262	462	1,848	17,184	N/A	15,336
1	262	462	1,848	14,314		12,466
2	262	462	1,848	13,275		11,427
3	262	462	1,848	13,202		11,354
4	262	462	1,848	13,450		11,602
5	295	495	1,980	13,560		11,580
6	350	550	2,200	14,910		12,710
7	440	640	2,560	14,700		12,140
8	625	825	3,300	14,250		10,950
9	550	750	3,000	14,625		11,625
10	535	735	2,940	14,900		11,960
11	565	765	3,060	15,650	N/A	12,590
12	709	902	3,636	15,125	6,411	5,078
13	650	850	3,400	14,400	6,411	4,589
14	610	810	3,240	14,750	6,411	5,099
15	560	760	3,040	14,950	6,411	5,499
16	635	835	3,340	14,500	6,411	4,749
17	550	750	3,000	15,200	N/A	12,200
18	535	735	2,940	16,600		13,660
19	495	695	2,780	16,950		14,170
20	445	645	2,580	15,850		13,270
21	445	645	2,580	15,350		12,770
22	445	645	2,580	16,917		14,337
23	315	515	2,060	17,050	N/A	14,990

\+ 5 Hour burn - Original Data

* Required MBTUH Load Column includes Domestic Hot Water Requirements taken from Jan 22 to 23 Indirect Process Profile Composite

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 2 OF 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM1853

Data Set III a Jan. 23

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data

2. Heating Profile Composite " " " " "

3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data.

Hour	KW Load: Elec. only	KW Load: Total incl. parasitic Elec + 200	Recoverable MBH Total KW × 4	Tons of Adsorp. Refrig	Required MBH (Total) Cooling/Heat. + DHW	Available[+] MBH from Incinerator	Required MBH from Boiler
24	262	462	1848	N/A	17,050	N/A	15,202
1	262	462	1848		17,075		15,227
2	262	462	1848		15,675		13,827
3	262	462	1848		15,502		13,654
4	262	462	1848		15,755		13,907
5	295	495	1980		16,110		14,130
6	350	550	2200		17,509		15,309
7	440	640	2560		17,190		14,630
8	625	825	3300		16,800		13,500
9	550	750	3000		16,725		13,725
10	535	735	2940		16,075		13,135
11	565	765	3060		16,450	N/A	13,390
12	709	902	3636		15,250	6,411	5,203
13	650	850	3400		14,280	6,411	4,469
14	610	810	3240		14,450	6,411	4,799
15	560	760	3040		14,260	6,411	4,809
16	635	835	3340		14,100	6,411	4,349
17	550	750	3000		14,555	N/A	11,555
18	535	735	2940		16,120		13,180
19	495	695	2780		16,075		13,295
20	445	645	2580		15,285		12,705
21	445	645	2580		15,010		12,430
22	445	645	2580		16,567		13,987
23	315	515	2060		16,150	N/A	14,090

+ 5 Hour burn - Original Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ________ DATE ________ SUBJECT FT. BELVOIR SHEET NO. 3 OF 6

CHKD. BY ________ DATE ________ HEAT RECOVERY CALCULATIONS JOB NO. AM1853

Data Set III C JANUARY 24

REFERENCES by G.K.C. Inc

1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Domestic Hot Water Profile " " " " "
(Indirect Process Profile Composite)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elec + 193	Recoverable MBH Total KW x 4	Required MBH (total) Heating + DHW	Available MBH from Inciner. +	Required MBH from Boiler
24	258	451	1,804	16,060	N/A	14,256
1	258	451	1,804	14,982		13,178
2	258	451	1,804	13,768		11,964
3	258	451	1,804	13,536		11,732
4	258	451	1,804	13,536		11,732
5	258	451	1,804	13,536		11,732
6	270	463	1,852	14,375		12,523
7	375	568	2,272	13,980		11,708
8	620	813	3,252	13,425		10,173
9	625	818	3,272	13,300		10,028
10	600	793	3,172	12,925		9,753
11	648	841	3,364	12,800	N/A	9,436
12	645	838	3,352	11,955	6,411	2,192
13	550	743	2,972	11,192	6,411	1,809
14	451	644	2,576	11,210	6,411	2,223
15	451	644	2,576	11,450	6,411	2,553
16	465	658	2,632	11,351	6,411	2,308
17	440	633	2,532	11,770	N/A	9,238
18	475	668	2,672	12,550		9,878
19	450	643	2,572	12,550		9,978
20	410	603	2,412	12,125		9,713
21	410	603	2,412	11,950		9,538
22	350	543	2,172	12,700		10,528
23	300	493	1,972	12,875	N/A	10,903

\+ 5 Hour burn - Original Data.

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ... DATE 7/27/76 SUBJECT FT. BELVOIR SHEET NO. 4 OF 6

CHKD. BY ... DATE ... HEAT RECOVERY CALCULATIONS JOB NO. AHA 1853

Data Set III c AUGUST 19

REFERENCES. by G. K. C., Inc.
1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile " " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from same Weather Tape)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elect + 447	Recoverable MBH Total KW times 4	Tons of Absorp Refrig.	Required MBH (total) Cool + DHW	Available+ MBH from Incinerator	Required MBH from Boiler
24	262	709	2,836	42	3,490	N/A	654
1	262	709	2,836	42	3,465		629
2	262	709	2,836	42	1,965		0
3	262	709	2,836	27	1,292		0
4	262	709	2,836	27	1,295		0
5	295	742	2,968	42	1,600		0
6	350	797	3,188	22	2,242		0
7	440	887	3,548	90	3,482		0
8	625	1,072	4,288	232	5,444		1,156
9	550	997	3,988	322	7,106		3,118
10	535	982	3,928	361	7,879		3,951
11	565	1,012	4,048	407	9,713	N/A	5,665
12	709	1,157	4,628	487	11,391	6,411	352
13	650	1,097	4,388	510 ①	11,110	6,411	311
14	610	1,057	4,228	510 ①	11,630	6,411	991
15	560	1,007	4,028	510 ①	11,580	6,411	1,141
16	635	1,082	4,328	510 ①	11,430	6,411	691
17	550	997	3,988	510 ①	11,360	N/A	7,372
18	535	982	3,928	507	12,496		8,568
19	495	942	3,768	361	9,704		5,936
20	445	892	3,568	252	6,584		3,016
21	445	892	3,568	217	5,549		1,981
22	445	892	3,568	207	7,036		3,468
23	315	762	3,048	185	6,095	N/A	3,047

① Cooling Profile Composite Loads for these hours exceed installed capacity. Therefore maximum capacity of absorption machine was used.

+ 5 Hour Burn - Original Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 5 OF 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AC11853

Data Set III c Aug 20

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load: Elec only	KW Load: Total incl. parasitic Elec. +447	Recoverable MBH Total KW times 4	Tons of Adsorp. Refrig	Required MBH (Total) cooling/Htg + DHW	Available MBH from Incinerator +	Required MBH from Boiler	
24	262	709	2,836	157	5,319	N/A	2,483	
1	262	709	2,836	157	5,319		2,483	
2	262	709	2,836	131	3,588		752	
3	262	709	2,836	136	3,309		473	
4	262	709	2,836	122	3,054		218	
5	295	742	2,968	99	2,636		0	
6	350	797	3,188	107	3,842		654	
7	440	887	3,548	174	4783		1,235	
8	625	1,072	4,288	278	6254		1,966	
9	550	997	3,988	330	7,268		3,280	
10	535	982	3,928	351	7,652		3,724	
11	565	1,012	4,048	361	8,864	N/A	4,816	
12	709	1,157	4,628	445	10,457	6,411	0	582 MBH Excess
13	650	1,087	4,388	403	9,043	6,411	0	1,756 " "
14	610	1,057	4,228	432	10,226	6,411	0	413 " "
15	560	1,007	4,028	434	10,252	6,411	0	187 " "
16	635	1,082	4,328	463	10,584	6,411	0	155 " "
17	550	997	3,988	324	7,710	N/A	3,722	
18	535	982	3,928	278	8,124		4,196	
19	495	942	3,768	199	6,833		3,065	
20	445	892	3,568	118	4,548		950	
21	445	892	3,568	122	4,159		591	
22	445	892	3,568	122	5,811		2,243	
23	315	762	3,048	82	4,590	N/A	1,542	

+ 5 Hour burn - Original Data

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 6 OF 6
CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM 1853
Data Set III C Aug 21

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load Elect. only	KW Load Total incl. Parasitic Elect.+447	Recoverable MBH Total KW times 4	Tons of Absorp. Refrig	Required MBH (total) cooling/Heat. + D.H.W.	Available+ MBH from Incinerator	Required MBH from Boiler	
24	258	705	2820	70	4060	N/A	1,240	
1	258	705	2820	40	2150		0	
2	258	705	2820	36	856		0	
3	258	705	2820	3	196		0	
4	258	705	2820	-8	136		0	
5	258	705	2820	-9	136		0	
6	265	712	2848	-10	850		0	
7	370	817	3268	80	2450		0	
8	665	1112	4448	128	1501		0	
9	625	1072	4288	215	4955		667	
10	600	1047	4188	324	7780		3,592	
11	648	1095	4380	332	7427	N/A	3,047	
12	635	1082	4328	378	8503	6,411	0	2,236 MBH Excess
13	560	1007	4028	407	8088	6,411	0	2,351 " "
14	460	907	3628	415	8479	6,411	0	1,560 " "
15	465	912	3648	411	8634	6,411	0	1,425 " "
16	475	922	3688	437	9141	6,411	0	958 " "
17	435	882	3528	382	8098	N/A	4,570	
18	475	922	3688	315	6987		3,299	
19	450	897	3588	160	4270		682	
20	420	867	3468	70	2500		0	
21	420	867	3468	49	1980		0	
22	355	802	3208	35	2350		0	
23	300	747	2988	-3	1400	N/A	0	

+ 5 Hour burn - Original

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY ___ DATE 7/16/76 SUBJECT Ft. BELVOIR SHEET NO. 1 OF 6
CHKD. BY ___ DATE ___ HEAT RECOVERY CALCS JOB NO. AM1853
Data Set III d WINTER, January 22

Reference: G-K-C BASE ELECTRIC PROFILE – COMPOSITE. PEAK CONDITIONS FROM WEATHERTAPE 15454 DATA. COMPOSITE DATA FOR JAN. 22 to JAN. 23. PROFILE DATED 7-15-76 & Heating Profile Comp. Jan 22.

Hour	KW LOAD Electric Only	KW LOAD Total, incl parasitic (El. + 200)	Recoverable MBTUH Total KW x 4	Required * MBTUH (From Composite dated 7-15)	Available + from Incinerator MBTUH	Required from additional Boiler Source MBH
24	262	462	1,848	17,184	N/A	15,336
1	262	462	1,848	14,314		12,466
2	262	462	1,848	13,275		11,427
3	262	462	1,848	13,202		11,354
4	262	462	1,848	13,450		11,602
5	295	495	1,980	13,560		11,580
6	350	550	2,200	14,910		12,710
7	440	640	2,560	14,700		12,140
8	625	825	3,300	14,250		10,950
9	550	750	3,000	14,625		11,625
10	535	735	2,940	14,900		11,960
11	565	765	3,060	15,650	N/A	12,590
12	709	902	3,636	15,125	4,547	6,942
13	650	850	3,400	14,400	4,547	6,453
14	610	810	3,240	14,750	4,547	6,963
15	560	760	3,040	14,950	4,547	7,363
16	635	835	3,340	14,500	4,547	6,613
17	550	750	3,000	15,200	4,547	7,653
18	535	735	2,940	16,600	4,547	9,113
19	495	695	2,780	16,950	N/A	14,170
20	445	645	2,580	15,850		13,270
21	445	645	2,580	15,350		12,770
22	445	645	2,580	16,917		14,337
23	315	515	2,060	17,050	N/A	14,990

+ 7 Hour burn - Original Data
* Required MBTUH Load Column includes Domestic Hot Water Requirements taken from Jan 22 to 23 Indirect Process Profile Composite

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ________ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 2 OF 6

CHKD. BY ________ DATE ________ Heat Recovery Calculations JOB NO. AM1853

Data Set II d Jan. 23

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data.

Hour	KW Load		Recoverable MBH Total KW × 4	Tons of Adsorp. Refrig	Required MBH (Total) Cooling/Heat. + DHW	Available+ MBH from Incinerator	Required MBH from Boiler
	Elec. only	Total incl. parasitic Elec + 200					
24	262	462	1848	N/A	17,050	N/A	15,202
1	262	462	1848		17,075		15,227
2	262	462	1848		15,675		13,827
3	262	462	1848		15,502		13,654
4	262	462	1848		15,755		13,907
5	295	495	1980		16,110		14,130
6	350	550	2200		17,509		15,309
7	440	640	2560		17,190		14,630
8	625	825	3300		16,800		13,500
9	550	750	3000		16,725		13,725
10	535	735	2940		16,075		13,135
11	565	765	3060		16,450	N/A	13,390
12	709	902	3636		15,250	4,547	7,067
13	650	850	3400		14,280	4,547	6,333
14	610	810	3240		14,450	4,547	6,663
15	560	760	3040		14,260	4,547	6,673
16	635	835	3340		14,100	4,547	6,213
17	550	750	3000		14,555	4,547	7,008
18	535	735	2940		16,120	4,547	8,633
19	495	695	2780		16,075	N/A	13,295
20	445	645	2580		15,285		12,705
21	445	645	2580		15,010		12,430
22	445	645	2580		16,567		13,987
23	315	515	2060		16,150	N/A	14,090

+ 7 Hour burn - Original data

SP 10692A

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ______ DATE ______ SUBJECT FT. BELVOIR SHEET NO. 3 OF 6

CHKD. BY ______ DATE ______ HEAT RECOVERY CALCULATIONS JOB NO. AM1853

Data Set III d JANUARY 24

REFERENCES
by G.K.C. Inc

1. Electric Profile Composite from Weather Tape 15454 Data
2. Heating Profile Composite " " " " "
3. Domestic Hot Water Profile " " " " "
(Indirect Process Profile Composite)

Hour	KW LOAD Electric only	KW LOAD Total, incl. parasitic Elec + 193	Recoverable MBH Total KW x 4	Required MBH (total) Heating + DHW	Available MBH from Inciner. +	Required MBH from Boiler
24	258	451	1,804	16,060	N/A	14,256
1	258	451	1,804	14,932		13,176
2	258	451	1,804	13,768		11,964
3	258	451	1,804	13,536		11,732
4	258	451	1,804	13,536		11,732
5	258	451	1,804	13,536		11,732
6	270	463	1,852	14,375		12,523
7	375	568	2,272	13,980		11,708
8	620	813	3,252	13,425		10,173
9	625	818	3,272	13,300		10,028
10	600	793	3,172	12,925		9,753
11	648	841	3,364	12,800	N/A	9,436
12	645	838	3,352	11,955	4,547	4,056
13	550	743	2,972	11,192	4,547	3,673
14	451	644	2,576	11,210	4,547	4,087
15	451	644	2,576	11,450	4,547	4,417
16	465	658	2,632	11,351	4,547	4,172
17	440	633	2,532	11,770	4,547	4,691
18	475	668	2,672	12,550	4,547	5,331
19	450	643	2,572	12,550	N/A	9,978
20	410	603	2,412	12,125		9,713
21	410	603	2,412	11,950		9,538
22	350	543	2,172	12,700		10,528
23	300	493	1,972	12,875	N/A	10,903

+ 7 Hour burn - Original Data

SP 10M28

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ____ DATE 7/27/76 SUBJECT FT. BELVOIR — HEAT RECOVERY CALCULATIONS — AUGUST 19 SHEET NO. 4 OF 6

CHKD. BY ____ DATE ____ JOB NO. AM 1853

Data Set II d

REFERENCES. by G. K. C., Inc.
1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile " " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from same Weather Tape)

Hour	KW LOAD Electric only	KW LOAD Total, incl parasitic Elect + 447	Recoverable MBH Total KW times 4	Tons of Absorp Refrig.	Required MBH (total) Cooling + DHW	Available[+] MBH from Incinerator	Required MBH from Boiler
24	262	709	2,836	42	3,490	N/A	654
1	262	709	2,836	42	3,465		629
2	262	709	2,836	42	1,965		0
3	262	709	2,836	27	1,292		0
4	262	709	2,836	27	1,295		0
5	295	742	2,968	42	1,600		0
6	350	797	3,188	22	2,242		0
7	440	887	3,548	90	3,482		0
8	625	1,072	4,288	232	5,444		1,156
9	550	997	3,988	322	7,106		3,118
10	535	982	3,928	361	7,879		3,951
11	565	1,012	4,048	407	9,713	N/A	5,665
12	709	1,157	4,628	487	11,391	4,547	2,216
13	650	1,097	4,388	510 ①	11,110	4,547	2,175
14	610	1,057	4,228	510 ①	11,630	4,547	2,855
15	560	1,007	4,028	510 ①	11,580	4,547	3,005
16	635	1,082	4,328	510 ①	11,430	4,547	2,555
17	550	997	3,988	510 ①	11,360	4,547	2,825
18	535	982	3,928	507	12,496	4,547	4,021
19	495	942	3,768	361	9,704	N/A	5,936
20	445	892	3,568	252	6,584		3,016
21	445	892	3,568	217	5,549		1,981
22	445	892	3,568	207	7,036		3,468
23	315	762	3,048	185	6,095	N/A	3,047

① Cooling Profile Composite Loads for these hours exceed installed capacity. Therefore maximum capacity of absorption machine was used.

+ 7 Hour burn - Original Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 5 OF 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM 1853

Data Set III d Aug 20

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load: Elec Only	KW Load: Total incl. Parasitic Elect. +447	Recoverable MBH Total KW times 4	Tons of Adsorp. Refrig	Required MBH (Total) cooling/Htg + DHW	Available MBH from Incinerator +	Required MBH from Boiler	
24	262	709	2,836	157	5,319	N/A	2,483	
1	262	709	2,836	157	5,319		2,483	
2	262	709	2,836	131	3,588		752	
3	262	709	2,836	136	3,309		473	
4	262	709	2,836	122	3054		218	
5	295	742	2,968	99	2,636		0	
6	350	797	3,188	107	3,842		654	
7	440	887	3,548	174	4783		1,235	
8	625	1,072	4,288	278	6,254		1,966	
9	550	997	3,988	330	7,268		3,280	
10	535	982	3,928	351	7,652		3,724	
11	565	1,012	4,048	361	8,864	N/A	4,816	
12	709	1,157	4,628	445	10,457	4,547	1,282	
13	650	1,087	4,388	403	9,043	4,547	108	
14	610	1,057	4,228	432	10,226	4,547	1,451	
15	560	1,007	4,028	434	10,252	4,547	1,677	
16	635	1,082	4,328	463	10,584	4,547	1,709	
17	550	997	3,988	324	7,710	4,547	0	825 MBH Excess
18	535	982	3,928	278	8,124	4,547	0	351 " "
19	495	942	3,768	199	6,833	N/A	3,065	
20	445	892	3,568	118	4,548		980	
21	445	892	3,568	122	4,159		591	
22	445	892	3,568	122	5,811		2,243	
23	315	762	3,048	82	4,590	N/A	1,542	

+ 7 Hour burn - Original Data

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

BY ______ DATE 7/28/76 SUBJECT Ft. Belvoir SHEET NO. 6 OF 6

CHKD. BY ______ DATE ______ Heat Recovery Calculations JOB NO. AM 1853

Data Set III d   Aug 21

Ref.: 1. Electric Profile Composite from Weather Tape 15454 Data
2. Cooling Profile Composite " " " " "
3. Indirect Process Profile Composite (Domestic Hot Water) from Weather Tape 15454 Data

Hour	KW Load Elect. only	Total incl. Parasitic Elect.+447	Recoverable MBH Total KW times 4	Tons of Adsorp. Refrig	Required MBH (total) Cooling/Heat. + D.H.W.	Available+ MBH from Incinerator	Required MBH from Boiler	
24	258	705	2820	70	4060	N/A	1,240	
1	258	705	2820	40	2150		0	
2	258	705	2820	36	856		0	
3	258	705	2820	3	196		0	
4	258	705	2820	-8	136		0	
5	258	705	2820	-9	136		0	
6	265	712	2848	-10	850		0	
7	370	817	3268	80	2450		0	
8	665	1112	4448	128	1501		0	
9	625	1072	4288	215	4955		667	
10	600	1047	4188	324	7780		3,592	
11	648	1095	4380	332	7427	N/A	3,047	
12	635	1082	4328	378	8503	4,547	0	372 MBH Excess
13	560	1007	4028	407	8088	4,547	0	487 MBH "
14	460	907	3628	415	8479	4,547	304	
15	465	912	3648	411	8634	4,547	439	
16	475	922	3688	437	9141	4,547	906	
17	435	882	3528	382	8098	4,547	24	
18	475	922	3688	315	6787	4,547	0	1114 MBH Excess
19	450	897	3588	160	4270	N/A	682	
20	420	867	3468	70	2500		0	
21	420	867	3468	49	1980		0	
22	355	802	3208	35	2350		0	
23	300	747	2988	-3	1400	N/A	0	

+ 7 Hour burn - Original data

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY S.T. DATE SUBJECT Heat Recovery From Incinerator - Ed'Weir Model SHEET NO. 1 OF 1
CHKD. BY DATE JOB NO. E4 1653
Data Sheet III

Recoverable Heat = Q_R in MBH

$$Q_R = \left(\frac{Q_A}{B} + F \right) e$$

Q_A = Heat available in waste in MBH

B = Burn time

e = efficiency of heat recovery system = 50%

F = Auxilliary heat input - From Consumat Catalog
for C 325 & 7 hr burn
F = 1900 MBH

for C 550 & 5 hr burn

F = 2750 MBH

Q_A = 31,180.4 MBTU Revised Data
= 50,358 MBTU Original Data

Data	Burn Time	QA (MBTU)	QA/B (MBH)	F (MBH)	e	QR (MBH)
Orig	7	50,358	7,194	1900	.5	4547
"	5	50,358	10,072	2750	.5	6411
Revised	7	31,180.4	4454	1900	.5	3177
"	5	31,180.4	6236	2750	.5	4493

CHAPTER VI

GENERAL DESCRIPTION AND SPECIFICATION FOR A CENTRAL CONTROL AND MONITORING SYSTEM

INDEX

General Description and Specification
for
A Central Control and Monitoring System (CCMS)

1.0. GENERAL DESCRIPTION

The pertinent monitoring points selected for the system give the operator real time information concerning the total operation of the Total Utility Plant. By monitoring load levels, fuel usage, electrical and thermal energy outputs, the system calculates the performance of each major plant component and utilizes the equipment with optimum efficiency.

The monitoring of each component as to "on-off" status, alarms, and safeties, coupled with commandability insures the equipment's reliability and project information for preventative maintenance programs.

The Central Control and Monitoring System is composed of (1) A central processing unit to scan the selected point as described on the flow diagrams, direct the gathering of information, process the data, and interface the peripheral devices. (2) An operator's terminal to provide the man-machine interface and designed for ease of system operation and understanding. (3) A data logger to provide hard copy printout of all information in the system.

The Total Utility Plant is made up of a Complete Central System which in turn is divided into (9) nine subsystems.

1.1 Central System:

Monitoring points: thermal and electrical energy usage at the following points:

1.1.1 Input

1. (GPM) Boiler Fuel
2. GPM. Engine Fuel
3. BTU/hr. from incinerator
4. BTU/hr. heat pick up from oil cooler.

1.1.2 Output

1. KW/hr. Electrical output to site and plant.
2. BTU/hr. Absorber-site and plant
3. BTU/hr. Heat exhanger (HX-1) site and plant Heating and Domestic Hot Water
4. BTU/hr. Heat exchanges HX-3, HX-4 and (HX-2) Sewage treatment and emergency.
5. BTU/hr. Dry cooler-excess heat

6. BTU/hr. Heat exchanges HX-7, HX-8
   Low temperature energy
7. BTU/hr. Raw Water Dry Cooler
8. BTU/hr. Heat exhanger HX-5
   Cooling lower winterizer

1.2 Chiller System:

Monitoring points; Run status and abnormal change of state alarm for all pumps, chillers and cooling towers, temperature indication for all pertinent areas, thermal and electrical energy usage of all equipment, and thermal energy generated by each chiller.
Command points; ability to start and stop all equipment and adjust load levels.
Calculations; B.T.U. output of each chiller as well as total thermal output of the system.
Efficiency of chiller in cost per ton.

1.3 Boiler System:

Monitoring points; run status and change of state alarms for all pumps, boilers and associated equipment, safety circuit of boiler panels, temperature indicator of all pertinent parts, electrical and fuel usage of all pertinent equipment.

Command points; ability to start and stop each piece of equipment manually or through a program. Adjust load level of each boiler.
Calculations; thermal energy output of each boiler, and of the total boiler system. Efficiency of each boiler in BTU/gallon of fuel and automatic operation of most efficient boiler.

1.4 Engine System:
Monitoring points; run status and abnormal change of state alarm for each component, temperature indicator and alarm for all pertinent points, electrical energy output and usage of all pertinent equipment and fuel usage of each engine.
Command points; start-stop command for all engines.
Calculations; thermal energy output of each engine as well as the total engine system. Efficiency of each engine in KW output per gallon of fuel. Thermal output of jacket muffler circuits oil cooler circuits, after cooler circuit.

1.5 High Temperature Thermal Loop:
Monitoring points; run status and abnormal change of state alarm for each component, temperature indication and alarm for all pertinent points.
Command points; start-stop command for all pumps and adjustment of hot water supply to primary loop.
Calculations; thermal energy input to primary loop.

1.6 Hot Water Supply System:
Monitoring points; run status and abnormal change of state alarm for all pumps, and temperature indication and abnormal alarm for all pertinent points.
Command points; ability to start and stop all equipment and adjust load levels manually or automatically via programs.
Calculations; thermal energy input from primary loop and thermal energy output of secondary loop.

1.7 Primary Loop Cooling System (i.e., miscellaneous heat exchanger, sludge heat exchanger, aeration heat exchanger, dry cooler, and emergency heat exchanger):
Monitoring points; run status and abnormal change of state alarm for all pumps. Temperature indication and abnormal alarm for all pertinent points.
Command points; start-stop for all pumps and fans and flow/no flow for all exchangers.
Calculations; thermal energy (BTU) removed from primary loop for each component part.

1.8 Diesel Fuel Supply System:
Monitoring points; run status of pumps, and high and/or low level alarms for each storage tank.

1.9 Plant Air Handling Unit:
Monitoring points; run status and alarm for all fans and pumps, temperature indication and alarm for all pertinent points and electrical energy usage of fans and pumps.
Command points; start-stop command for main supply fan.
Calculations; thermal energy consumed, both heating and cooling to be deducted from the total utility system.

1.10 Oil Cooler System:
Monitoring points; run status of all pumps and fans, temperature indication and abnormal alarm of all pertinent points.
Calculations; thermal energy removed from primary loop (BTU).

2.0. SUMMARY

2.1 In summary, all of the information described above will give a clear and concise indication of the operating performance of each major plant component. With information such as thermal and electrical energy input and output and equipment efficiency, a program can be implemented to operate the total utility plant to its optimum efficiency. For example, if the engines are not producing enough heat to maintain the temperature of the primary loop, additional heat must be generated from the high temperature loop if available, or from the boiler system. If the boiler system is used, operate the boiler which is most efficient (BTU/ gallon fuel).

2.2 Equal to the importance of operating efficiently is reliability and maintenance of the Total Utility complex. The monitoring and command points selected will provide the operator a total view of the performance of all of the major equipment. If a malfunction should occur, the operator will be able to take immediate action to correct the problem with minimum of downtime.

3.0. GENERAL SPECIFICATION

3.1 The Central Control and Monitoring System (CCMS) specified under this section shall be totally solid-state using computer oriented digital technology to insure long life and low maintenance costs to be consistent with this project's life cycle costing concepts. The system must be a standard with the manufacturer to insure on-going parts availability and trained technical support. The initial installation must include all pushbuttons, indicators, switches, pilot indicators, digital and analog value displays, phone line interface equipment and software, etc., to make it a completely operable system. The initial installation shall have the capacity to handle a minimum of 1000 data points. The CCMS must be designed in a modular fashion to insure future expansion capability whether it be additional data gathering panels or central console function capability. The CCMS is specified herein to help insure proper and efficient utilization of the mechanical and electrical systems and/or to insure a high level of life and property protection.

3.2 The CCMS shall be designed such that no operator intervention is required to restart the system after a power failure of up to eight (8) hours. During this time the system shall not lose any portion of its program or data file.

4. 0. SYSTEM DESCRIPTION

4.1 Data Transmission System

All data transmitted between the CCMS (Central Control and Monitor System) central processing unit (CPU) and the remote data gathering panels must be transmitted in digital form. A double transmission, echo transmission, or multiparity bit technique must be used to insure message integrity. Transmission system failure must be annunciated immediately as a "no response" with display and/or printout of time and address of the area failing to respond. For systems with a printer, an hourly log of all remote groups not responding can be provided.

All analog signals must be converted to digital values within 250 feet of the sensing point to insure against stray voltage pickup and/or signal degradation. The same reliability measures stated for digital signal transmission applies to the converted analog signals, i.e., double transmission, echo transmission or parity check must be provided.

5.0. CCMS CAPABILITIES

5.1 Operator's Terminal

An Operator's Terminal (OPT) can be provided and should be considered the main man-machine interface. The OPT shall be designed for ease of system operation and understanding. The terminal shall have point address selection buttons, a series of function buttons and a locking capability and a digital readout display as described herein.

The Operator's Terminal shall be designed for desk-top operation and should require no more desk space than a desk-top calculator.

The CCMS shall fit the space allotted per the job drawings.

The OPT shall be supplied with long life digital indicators and light emitting diodes for pilot indication and temperature valve indication to insure long life and minimum maintenance. Systems using incandescent lights for pilot lamp or back-lighted digital displays shall have supervised filaments with discrete alarm point assignment.

Serial entry touch dial selection buttons shall be supplied with the system and shall be used for: access to remote control and data points, adding, deleting or resetting of alarm limits in memory; resetting program start/stop times; and adding or deleting start/stop program channels.

Clearly identified individual function buttons shall be provided to make the system easier to operate and more easily understood.

The system must contain the following individual control buttons:

Start	Intercom Off
Stop	Alarm Summary
Reset/Auto	Data Display
Increase/Open	Graphics-On
Decrease/Close	Graphics-Off
Alarm Acknowledge	Lamp Test
Intercom On	Time Display

Systems that require the operator to type out an instruction, i.e., (ALA SUM) on a typewriter type keyboard as a standard item shall include appropriate interface to perform the above specified single-entry capability.

The system shall have the capability of addressing and digitally displaying analog values and their engineering parameters such as degrees, R.H., PSI, KW, etc. To insure ease of system operation and understanding, systems not displaying point identification, point value and engineering unit simultaneously are not acceptable. The system shall have a minimum vocabulary of 16 units as listed below and shall be field programmable.

Degrees F	Percent
Degrees Celcius	Gallons per minute
Relative Humidity	Tons
Pounds per square inch	Kilowatts
Inches	Amps
Wet Bulb	Volts
Dew Point	BTU's
Hours	Kilowatt Hours

The transmission of temperature, pressure or other analog values from remote data gathering panels to the central processor shall be in true digital form to eliminate transmission errors. The analog sensing, transmission, and display system must have end to end accuracy of $\pm$ 0.1°F.

The system shall display real clock time in 24-hour format. The time shall be resettable by simple keyboard entry.

Two and three-mode control capability shall be provided for remote control of motor loads or change-over functions, such as on-off, occupied-unoccupied, summer-winter, ON-OFF-AUTO, HTG-CLG, etc. Selection of a specific control point shall cause the display of the address and the current operating status.

The CPU shall automatically lock out alarms for a period of time after an automatic or manual start command has been issued to a remote piece of equipment. This time delay shall eliminate false alarming of equipment and allow for the transfer of differential pressure or flow switches.

The system shall have the capability of digitally resetting the control point of remote controllers or dampers and other operators from the central console. It shall be capable of resetting and reading the control position by a positive feedback circuit from the remote local loop control circuit. Positive feedback from the DGP of he new position after reset shall be displayed in a digital form in the readout windows.

The CCMS shall have the capability to continuously monitor analog and digital alarm conditions. Upon alarm condition the system will immediately sound the audible alarm, show the point identification number in alarm and also the engineering unit associated with the specific alarm. The capability to indicate whether an alarm value is high or low shall also be included.

The CCMS shall have the capability of setting individual alarm limits for each analog input point resettable from the Operator's Terminal (OPT). Anthorized console operators shall have the capability of assigning or changing alarm limits at any time without interrupting system operations. It shall also be possible to read back assigned high and low alarm limits at any time. The system shall also have the capability to assign analog lockout on a point by point basis. The lockout of an analog point shall be assignable to any digital point within the DGP. Analog lockout is required to prevent false alarm conditions.

The system shall contain a solid-state audible alarm which shall be initiated with every new alarm indication. Each new contact or analog alarm shall resound the audible alarm which shall be silenced by the manual alarm acknowledge button on the central control console. The audible alarm shall not sound on the return to normal for mechanical system type alarms but must sound on return to normal of fire alarms.

The OPT shall be furnished with a single pushbutton which shall light all pilot indicators or light emitting diodes (LED's) when operated.

The CCMS shall be supplied with at least three locking levels for operator access. With level one disabled the CCMS shall receive and record alarms and automatically program equipment but the point selection, alarm acknowledgement, and all function buttons shall be inoperative. With level one enabled all point selection and function buttons shall be operative to perform normal system operation.

Level two shall enable/disable the programming of analog alarm limit and automatic time programs. By enabling this level the operator can assign new analog alarm limits and reprogram start/stop times. With this level disabled the system will automatically compare limits and operate equipment at its programmed time.

Level three allows for the addition and deletion of system input/output points and control of display and printout assignments.

5.2 Firmware Options

The system shall have the capability of initiating commands (start/stop, secure/access, day/night, etc.) to system points on a pre-set time schedule. Capacity for up to 30 seven-day time programs shall be provided. Separate start and stop times for each day of the week shall be provided with provision for a holiday schedule program. It shall be possible to set the holiday schedule seven days in advance of the holiday and the program shall automatically revert to the regular time schedule after the holiday program is executed. The holiday schedule shall be capable of handling any holidau period from one to four days.

The system shall have the capability of automatically initiating commands upon an alarm occurrence. Any point may be assigned as an event initiator.

A change of status at the alarm initiator shall cause a predefined series of commands, called an event program, to occur. A total of up to 100 separate event programs shall be provided with the capability of handling up to 24 points per program.

It shall be possible to assign limit values to analog inputs on a per point basis. Both high and low limit values per point shall be possible. In addition it shall be possible to automatically lock out analogs on a per point basis when the associated primary equipment is shut down.

6.0. PERIPHERAL OPTIONS

6.1 Printer Module

A printer shall be supplied with the CCMS to provide a hard copy printout of alarm records and logging functions. Change of state information including new alarms, restoration of alarms and alarm acknowledgments shall be printed along with demand logs such as all points, status summary, and alarm summary. It shall also be possible to demand a printout of the contents of the CPU memory. All alarms shall be printed in red, all other conditions shall be printed in black.

6.2 Intercom Module

An intercom capability shall be provided for audio communication between the CCMS location and the remote points, and audio monitoring of the operating condition of remotely located equipment. Speaker assemblies shall be provided as specified as an integral part of the

remote DGP's. The intercom module shall have separate in volume and out volume controls.

6.3 Data Gathering Panels

Data gathering panels (DGP's) for collection of input data shall be furnished as required to meet system requirements and to minimize the length of wiring runs from sensors and actuators. DGP's must be able to handle start/stop commands, control point adjustments, damper positioning, digital alarm and status inputs and any intermix of analog inputs such as temperature, humidity, pressure and other industrial type millivolt inputs.

All analog signals entering the DGP shall be converted to error free digital signals for transmission to the central processor unit (CPU). Transmission from DGP to the CPU shall not be limited to hardware only, but shall be capable of transmission via commercially available voice grade telephone circuits.

The input/output (I/O) summary herein specifies the required data inputs and central functions for this CCMS.

CHAPTER VII

SPECIFICATIONS FOR OTHER EQUIPMENT

1.0 Boilers - MIL B-18897D Boilers, heating, low pressure.

2.0 Tanks - MIL T-462C Tanks, liquid storage, metal, fuel-oil horizontal.

3.0 Tanks - MIL T-12295C Tanks, hot water storage.

4.0 Pumps - MIL P-16077A (DOCKS) Pumps, centrifugal water circulating, electric motor driven.

5.0 Cooling Towers - MIL C-16278D (DOCKS) Cooling towers, liquid.

6.0 Expansion Tank - MIL-T-18560A Tanks, expansion, hot water heating system.

7.0 Electric Chiller - MIL C-21976A (YD) Chiller unit, liquid, packaged, centrifugal, electic-motor driven, 50 tons and above.

8.0 Dry Cooler - MIL-C-22015 (DOCKS) Coolers, fluid, dry type, (packaged unit).

CHAPTER VIII

Cost Estimate Report

COST ESTIMATE
TOTAL UTILITY SYSTEM
FORT BELVOIR, VA.

TAG	EQUIPMENT DESCRIPTION	QUN	MATERIAL	LABOR	TOTAL
EG-1-4	Cat. D398 Engines	4	300000	16000	316000
HRM-1-4	Heat Recovery Mufflers	4	16000	8000	24000
M-1-4	Exhaust Silencers	4	1964	4000	5964
PHWP-1-3	Primary HW Pumps	3	6600	2400	9000
B-1-3	Boilers 150 HP	3	-	-	84000
BHWP-1-3	Boiler HW Pump	3	1800	900	2700
HX-1	Heat Exchanger	1	5000	2000	7000
SHWP-1-3	Secondary HW Pumps	3	6600	2400	9000
HWP-1	Plant Heating Pumps	1	480	300	780
HX-4	Sludge Heat Exchanger	1	2450	1200	3650
HX-3	Rotation Disc HX	1	2450	1200	3650
HX-2	Emergency HX	1	5500	2000	7500
DCJW-1	Jacket Dry Cooler	1	17000	3000	20000
25000 GAL.	Thermal Storage Tank	1	-	-	6000
TSHWP-1-2	Thermal HW Pumps	2	1200	1000	2200
S-1	Air Handling Unit w/ coils	1	-	-	14000
	Engine Controls	5	60000	-	60000
ET-1 & 2	Expansion Tanks	2	2500	1800	4300
	Boiler Flues	3	-	-	1800
	Setting of Engines	4	-	8000	8000
	Piping, Va. & fittings		-	-	78500
	Ductwork		-	-	20000
	Exhaust fans	7	13000	4200	17200
	Temp. Control System		-	-	30000
AS - 1 & 2	Air separators	2	-	-	3000
GEF - 1	Glycol fill tanks 30 gal.	2	-	-	700
	Insulation				25000
					$ 763944

COST ESTIMATE
TOTAL UTILITY SYSTEM
FORT BELVOIR, VA.

TAG	EQUIPMENT DESCRIPTION	QUN	MATERIAL	LABOR	TOTAL
DCRW - 1	Dry Cooler	1	7600	1600	9200
HX - 6	Emergency Heat Exchanger	1	3450	1000	4450
ET - 4	Expansion tank 300 gal.	1	-	-	1200
GEF - 1	Glycol fill tank 30 gal.	1	-	-	350
HWP-3-5	Hot water pumps	3	-	-	7600
HX - 7	Heat Exchanger	1	2600	1000	3600
HX - 8	Heat Exchanger	1	2600	1000	3600
	Va., Pipe & fittings		-	-	21860
AS - 3	Air separator	1	900	400	1300
	Insulation				6000
					$ 59,160

CH - 1	Absorber 622 tons	1	-	-	91300
CH - 3	Cent. Chiller 118 tons	1	-	-	30800
AHWP-1 & 2	Hot water pumps	2	-	-	4800
CTP-1 & 3	Condenser pumps	3	-	-	10000
CTP - 2	Condenser pumps	1	-	-	2400
CT - 1	Cooling tower	1	24320	4000	28320
CTFP-1	Pump	1	-	-	1700
ACWP-1	Pump	1	-	-	1700
HX - 5	Heat Exchanger	1	3000	1000	4000
	Chemical feed	1	-	-	2500
					$ 177,520

COST ESTIMATE
TOTAL UTILITY SYSTEM
FORT BELVOIR, VA.

TAG	EQUIPMENT DESCRIPTION	QUN	MATERIAL	LABOR	TOTAL
CHWP-1&2	Chilled water pumps	2	-	-	12000
PCHWP -1	Chilled water pump	1			2400
PCHWP -2	Chilled water pump	1			1800
AS -4	Air separator	1			1700
ET -3	Expansion tank	1			3000
	Pipe, va. & fittings				40000
	Insulation				8000
					$ 68900

TAG	EQUIPMENT DESCRIPTION	QUN	MATERIAL	LABOR	TOTAL
DOSDT-1&2	Diesel Str. day tank 1000 gal.	2	3000	1200	4200
DOCT-1	Diesel charging tk. 1000 gal.	1	1500	600	2100
DOST-1&2	Diesel Storage 25,000 gal.	2	-	-	21000
DOP-1&2	Oil pumps	2	-	-	1800
DOP-3&4	Oil piping, Va. & fittings				15000
LOSWT-1	Lub. oil waste tk 4000 gal.	1	-	-	3000
LOST-1	Lub. oil storage tk. 4000 gal.	1	-	-	3000
LOSDT-1	Lub. oil day stor. tk. 1000 gal.	1	1500	600	2100
LOP-1&2	Lub. oil pumps	2	-	-	1800
	Lub. oil piping, Va. & fittings		-	-	9000
	Tank excavations & fill		-	-	5600
					$ 68600

COST ESTIMATE
TOTAL UTILITY SYSTEM
FORT BELVOIR, VA.

TAG	EQUIPMENT DESCRIPTION	QUN	MATERIAL	LABOR	TOTAL
ACE - 1 & 2	Air compressors with tanks	2	-	-	50000
	Ref. air drier	1			800
	Pipe, Va. & fittings				7000
					57800
	Monitoring & data acq. system				140000
	Elect. power wiring				212825
	Elect. lighting $2^{\underline{00}}$/ □'				22800
	Elect. motor wiring				51532
	Building 11,400 □ $15^{\underline{00}}$/ □'				171000
	Toilet room fixtures				1000
	Water heater				138
	Floor drains				1000
	Roof drains				1200
	Cast iron piping (soil)				25000
	Galvanize piping				9000
	Fire extinguishers				4000
	Sewage treatment				200000
	Incinerator				145000
	*Yard substation				230000
					$ 1214495
		GRAND TOTAL ± 10%			$ 2410419

* 12 kv Site Distribution

CHAPTER IX

CALCULATIONS

CHAPTER IX

CALCULATIONS

INDEX

BEST AVAILABLE COPY

Prepared by USA 12/6/74
Approved by
REV ⚠ USA 12/12/74
✓ REV AH 5/20/76

NOTE
MECH. SCHEDULE DATA ON EXIST.
DRWGS. NO. 80495

BEQ FORT BELVOIR, VIRGINIA # 4430
LOAD SUMMARY TAKE-OFF DATA

WINTER LOAD

BLDG #1 (#2 IS SIMILAR) LIVING MODULE BLDG 1st 2nd & 3rd FLRS.		QUANTITY	U	ΔT	HTG. FACTOR	TRANS. LOAD	INFIL LOAD	VENT. OA. LOAD
WALL	NW	1264.00	.20	57	11.4	25807		
"	NE	1224.00	.20	57	11.4	13953		
"	SW	1224.00	.20	57	11.4	13952		
"	SE	1511.30	.20	57	11.4	17225		
GLASS	NW	231.00	1.13	57	64.41	14876		
"	NE	666.00	1.13	57	64.41	42897		
⚠ "	SW	303.00	1.13	57	64.41	19516		
"	SE	231.00	1.13	57	64.41	14876		
⚠ " Shaded	SW	363.00	1.13	57	64.41	23,380		
P-E PANEL	NW	115.50	.19	57	10.83	1250		
"	NE	231.00	.19	57	10.83	2500		
"	SW	292.80	.19	57	10.83	3170		
"	SE	115.50	.19	57	10.83	1250		
LAT. LOAD FACTOR (5.0 × .68)		37.4						
ROOF		3658.00	.16	57	9.12	32650		
EDGE LOSS (MAIN UNIT)		275.00				11000		
INFILT. (Summer) 75 AC (AIR. KITCHEN)		1174.00						
VENT. O.A.		1440.00						88635
ELECT. (LIGHT) KW		9.60						
ELECT. (POWER) KW		15.15						
PEOPLE 245/205		48.00						
INFILT (WINTER) .5 AC		1074.00					66116	
CLG COIL CAP								
HTG COIL CAP								
TOTALS						238352	66116	88635

SUMMER LOAD

Item	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL NW	8	1.6	3622	1	.2	452			
WALL NE	8	1.6	1958	8	1.6	1958			
WALL SW	8	1.6	1958	2	.4	490			
WALL SE	8	1.6	2418	10	2.0	3022			
GLASS NW	16	18.08	4177				40		9240
GLASS NE	16	18.08	12041				32		21312
GLASS SW	16	18.08	5478				187		56661
GLASS SE	16	18.08	4176				34		7854
GLASS Shaded SW	16	18.08	6563				40		14520
P-E PANEL NW	8	1.52	176	12	2.28	263			
P-E PANEL NE	8	1.52	351	12	2.28	526			
P-E PANEL SW	8	1.52	451	21	3.99	1185			
P-E PANEL SE	8	1.52	176	21	3.99	461			
ROOF	8	1.28	4582	46	7.36	26349			
TOTALS			48027			34,106			109,587

Item	TOTAL GLASS LOAD	SUMMER INFIL SENS	SUMMER INFIL LAT	SUMMER VENT SENS	SUMMER VENT LAT	PEOPLE SENS	PEOPLE LAT	ELECT KW	ELECT BTUH	HTG. COIL CAP	CLG COIL CAP SENS	CLG COIL CAP LAT
1										[illegible]	[illegible]	[illegible]
2										[illegible]	[illegible]	[illegible]
INFILT. (Summer)		14703	40167									
VENT. O.A.				26495	53853							
ELECT. (LIGHT) KW								9.60	[illegible]			
PEOPLE						11760	9840					
CLG COIL CAP											142000	19878
HTG COIL CAP										417000		
TOTALS		14703	40167	26495	53853	11760	9840	3.6	12286	417000	142000	19878

NOTE - CALCULATIONS ARE BASED ON AUG 1st 2 P.M.
- INDOORS 75°/50%
- OUTDOORS 91°/77%

WINTER CONDITIONS
OUTDOOR DESIGN TEMP. = +15°FDB

INDOOR CONDITIONS
72°FDB

TOTAL HEATING LOAD = 326,987 BTUH

⚠ TOTAL SENSIBLE COOLING LOAD = 242,901 BTUH

TOTAL LATENT COOLING LOAD = 63,693

⚠ TOTAL COOLING LOAD = 306,594 BTUH

Prepared by USA 12/2/74
Rev △ USA 10/6/74
Rev AIA 5/20/76

NOTE
MECH SCHEDULE DATA ON EXIST.
DRWGS. NO 84485

REQ. FORT BELVOIR, VIRGINIA # 4430
LOAD SUMMARY TAKE-OFF DATA

WINTER LOAD

BLDG #10815 SIMILAR LIVING MODULE BLDG 1ST, 2ND & 3RD FLOORS		QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFIL LOAD	VENT. O.A. LOAD
WALL	NW	1511.30	.20	57	11.40	17228		
"	NE	1224.00	.20	57	11.40	13953		
"	SW	1224.00	.20	57	11.40	13953		
"	SE	2264.00	.20	57	11.40	25809		
GLASS	NW	231.00	1.13	57	64.41	14878		
"	NE	666.00	1.13	57	64.41	42897		
△ "	SW	303.00	1.13	57	64.41	19516		
"	SE	231.00	1.13	57	64.41	14878		
△ " Shaded	SW	363.00	1.13	57	64.41	23380		
P.E. Panel	NW	115.50	.19	57	10.83	1250		
"	NE	231.00	.19	57	10.83	2500		
"	SW	297.00	.19	57	10.83	3216		
"	SE	115.50	.19	57	10.83	1250		
LAT LOAD FACTOR		37.4						
ROOF (ft² - 60)		3580.00	.16	57	9.12	32650		
EDGE LOSS (concrete)		275.00				11000		
INFILT. (Summer)		1014.00						
VENT. O.A.		1440.00						88635
ELECT. (LIGHT) KW		3.60						
ELECT. (POWER) KW		.54						
PEOPLE 205/295		42.00						
INFILT. (WINTER)		1014.00					66116	
CLG COIL CAP.								
HTG COIL CAP								
TOTALS						238155	66116	88635

SUMMER LOAD

Item	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL NW	8	1.6	2418	1	.2	302			
WALL NE	8	1.6	1958	8	1.6	1958			
WALL SW	8	1.6	1958	2	.4	490			
WALL SE	8	1.6	3622	10	2.0	4528			
GLASS NW	16	18.08	4177				40		9240
GLASS NE	16	18.08	12041				32		21312
GLASS SW	16	18.08	5478				187		56661
GLASS SE	16	18.08	4176				34		7854
GLASS Shaded SW	16	18.08	6563				40		14520
P.E. Panel NW	8	1.52	176	12	2.28	263			
P.E. Panel NE	8	1.52	351	12	2.28	526			
P.E. Panel SW	8	1.52	451	21	3.99	1185			
P.E. Panel SE	8	1.52	176	21	3.99	461			
ROOF	8	1.28	4582	46	7.36	26349			
TOTALS			48127			36062			109587

Item	SUMMER INFIL SENS	SUMMER INFIL LAT	SUMMER VENT SENS	SUMMER VENT LAT	PEOPLE SENS	PEOPLE LAT	ELECT. KW	ELECT. BTUH	HTG COIL CAP.	CLG COIL CAP. SENS	CLG COIL CAP. LAT
									2-FC @ 208400 EA	12865 EA	4833 EA
									2-FC @ 138500 EA	1941 EA	1360 EA
INFILT. (Summer)	41703	40167									
VENT. O.A.			20435	53453							
ELECT. (LIGHT) KW							3.60	12286			
PEOPLE					11760	4840					
CLG COIL CAP.										348066	19278
HTG COIL CAP									417000		
TOTALS	41703	40167	20435	53253	11760	4840	3.6	12286	417000	348066	19278

NOTE: CALCULATIONS ARE BASED ON AUG 21ST 2 P.M.
- INDOORS 75°/50%
- OUTDOORS 91°/77° WB

	TOTAL HEATING LOAD	= 326,790 BTU/HR
△	TOTAL SENSIBLE COOLING LOAD	= 244,257 BTU/HR
	TOTAL LATENT COOLING LOAD	= 63,693 BTU/HR
△	TOTAL COOLING LOAD	307,950 BTU/HR

WINTER OUTDOOR DESIGN TEMP. = +15°F

INDOOR CONDITIONS 72°F DB

164

BEST AVAILABLE COPY

NOTE
MECH SCHEDULE DATA ON EXIST.
DWGS NO E4 485

Prepared by WSH 11/4/74
Approved by
REV △ WSH 12/4/74
REV RM 1/20/76

BEQ FORT BELVOIR, VIRGINIA # 4430
LOAD SUMMARY TAKE-OFF DATA

SUMMER LOAD

BLDG. #1 (#2 IS SIMILAR) SERV & LIV. MODULE A, C & D 1ST, 2ND & 3RD FLOORS		QUANTITY	U	WINTER LOADS ΔT	FACTOR	TRANS LOAD	INFIL LOAD	VENT/OA LOAD	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	1511.30	.20	57	11.4	17228			8	1.6	2418	1	.2	302			
"	NE	1224.00	.20	57	11.4	13953			8	1.6	1958	8	1.6	1958			
"	SW	1224.00	.20	57	11.4	13953			8	1.6	1958	2	.4	490			
"	SE	1511.30	.20	57	11.4	17228			8	1.6	2418	10	2.0	3022			
GLASS	NW	179.25	1.13	57	64.41	11157			16	18.08	3432				40		6930
"	NE	666.00	1.13	57	64.41	42897			16	18.08	12041				32		21312
△ "	SW	303.00	1.13	57	64.41	19516			16	18.08	5478				187		56661
"	SE	485.00	1.13	57	64.41	31234			16	18.08	8769				34		16490
△ " Shaded	SW	363.00	1.13	57	64.41	23380			16	18.08	6563				40		14520
P-E PANEL	NW	86.00	.19	57	10.83	931			8	1.52	131	12	2.28	196			
"	NE	297.00	.19	57	10.83	3216			8	1.52	451	12	2.28	677			
"	SW	297.00	.19	57	10.83	3216			8	1.52	451	21	3.99	1185			
"	SE	115.80	.19	57	10.83	1250			8	1.52	176	21	3.99	461			
LAT. LOAD FACTOR		30.60															
ROOF (18 x 60)		3580.00	.16	57	9.12	32650			8	1.28	4582	46	7.36	26349			
EDGE LOSS (LIN.FT)		260.00				10400											
INFILT. (SUMMER)		1074.00															
VENT O.A.		1500.00						92340									
ELECT (LIGHT) KW		6.96															
ELECT (POWER) KW		5.00															
PEOPLE 105/245		44.00															
INFILT. (WINTER)		1074.00					66116										
CLG COIL CAP																	
HTG COIL CAP																	
TOTALS						443210	66116	92340			50526			34640			115913

ITEM		SUMMER INFILT SENS	LAT.	SUMMER VENT SENS	LAT.	PEOPLE SENS	LAT	ELECTRIC KW	BTUH	HTG COIL CAP	CLG COIL CAP SENS	LAT.
WALL	NW									10-FC-4B 14000	12865	400
"	NE									5-FC-4A 19500	7951	1460
"	SW									8-FC-4B 21000	17319	2100
"	SE									1-FC-4C 18250	9702	550
										1-FC-4G 6500	—	—
INFILT. (SUMMER)		19703	40167									
VENT O.A.				27540	56400							
ELECT (LIGHT) KW								6.96	23755			
PEOPLE 105/245						10780	9020					
CLG COIL CAP											329395	20810
HTG COIL CAP										414850		
TOTALS		19703	40167	27540	56400	10780	9020	6.96	23755	414850	329395	20810

NOTE: CALCULATIONS ARE BASED ON AUG 21ST 2 P.M.
– INDOOR 75°/56%
– OUTDOOR 91°/77°

TOTAL HEATING LOAD = 334550 BTU/HR
△ TOTAL SENSIBLE COOLING LOAD = 261,154 BTU/HR
TOTAL LATENT COOLING LOAD = 65,420
△ TOTAL COOLING LOAD = 326,574

WINTER OUTDOOR DESIGN TEMP +15°F
INDOOR CONDITIONS 72°F DB

MECHANICAL SCHEDULE DATA
ON EXIST. DRWGS 84 & 85

MIUS FORT BELVOIR, VIRGINIA #4460
LOAD SUMMERY TAKE-OFF DATA

BUILDING NO 3
LIVING MODULE B.C.&D.
1ST 2ND & 3RD FLOOR

WINTER LOAD

Item	Quantity	U	ΔT °F	HTG Factor	Trans Load	Infiltr Loads	Vent Loads
WALL N.W.	1511.30 ⌀	0.20	57	11.4	17,229		
WALL N.E.	1224.00 ⌀	0.20	57	11.4	13,954		
WALL S.W.	1224.00 ⌀	0.20	57	11.4	13,954		
WALL S.E.	2264.00 ⌀	0.20	57	11.4	25,810		
GLASS N.W.	231 ⌀	1.13	57	64.4	14,876		
GLASS N.E.	666 ⌀	1.13	57	64.4	42,890		
ΔGLASS S.W.	303 ⌀	1.13	57	64.4	19,516		
GLASS S.E.	231 ⌀	1.13	57	64.4	14,876		
ΔGLASS S.W. SHADED	363 ⌀	1.13	57	64.4	23,380		
PE N.W.	115.5 ⌀	0.19	57	10.83	1,251		
PE N.E.	297 ⌀	0.19	57	10.83	3,216		
PE S.W.	297 ⌀	0.19	57	10.83	3,216		
PE S.E.	115.5 ⌀	0.19	57	10.83	1,251		
ROOF	3580.00 ⌀	0.16	57	9.12	32,650		
INFILTERATION (WINTER)	1074 CFM	1.08	57	61.56		66,115	
INFILTERATION (SUMMER)	1074 CFM	1.08	16				
VENTILATION (O.A.)	1440 CFM	1.08	57/16	61.56			88,635
ELECTRIC (LIGHTS)							
ELECTRIC (POWER)							
PEOPLE	48						
EDGE LOSS	275 FT.			40 BTU PER FT	11,000		
					239,069	66,115	88,635

SUMMER LOAD

Item	Wall, Roof & Glass Trans ΔT	Factor	Transm Load BTU/HR	Solar Wall & Roof Solar	Factor	Solar Wall & Roof Load BTU/HR	Solar Glass Solar	Factor	Solar Glass Load BTU/HR
WALL N.W.	8	1.6	2418	1	.2	302			
WALL N.E.	8	1.6	1958	8	1.6	1958			
WALL S.W.	8	1.6	1958	2	.4	490			
WALL S.E.	8	1.6	3622	10	2.0	4528			
GLASS N.W.	16	18.08	4177				40		9240
GLASS N.E.	16	18.08	12041				32		21312
ΔGLASS S.W.	16	18.08	5478				187		56661
GLASS S.E.	16	18.08	4176				34		7854
ΔGLASS S.W. SHADED	16	18.08	6563				40		14520
PE N.W.	8	1.52	176	12	2.28	263			
PE N.E.	8	1.52	451	12	2.28	677			
PE S.W.	8	1.52	451	21	3.99	1185			
PE S.E.	8	1.52	176	21	3.99	461			
ROOF	8	1.21	4532	46	7.36	26349			
			48,227			36213			109,587

Item	Summer Infiltr Sens	Summer Infiltr Lat	Summer Vent O.A. Sens	Summer Vent O.A. Lat	People Sens	People Lat	Electric KW	Electric BTUH	Exist HTG Coil Capacity	Existing Cooling Coil Capacity Sensible	Existing Cooling Coil Capacity Latent
INFILTERATION (SUMMER)	19,719	40,168									
VENTILATION (O.A.)			26,435	53,856							
ELECTRIC (LIGHTS)							3.6	12,362	(24) FC @ 14,000 BTUH EA (6) FC @ 13,500 BTUH EA	(24) FC @ 12,265 BTUH EA (6) FC @ 7,951 BTUH EA	(24) FC @ 405 BTUH EA (6) FC @ 1260 BTUH EA
PEOPLE					11,760	9,840					
	19,719	40,174	26,435	53,856	11,760	9,840	3.6	12,350	417,000	342,060	19,272

NOTE:
DESIGN CALCULATION ARE BASED ON AUGUST 21, 2PM.
OUTSIDE CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITIONS 75°FDB & 50% RH

WINTER CONDITIONS
OUTSIDE DESIGN TEMP = +15°FDB
INDOOR CONDITIONS 72°FDB

TOTAL HEATING LOAD	= 327,704	BTU/HR
Δ TOTAL SENSIBLE COOLING LOAD	= 244,574	BTU/HR
TOTAL LATENT COOLING LOAD	= 63,696	BTU/HR
Δ TOTAL COOLING LOAD	= 308,270	BTU/HR

CC 11/3/74
REV △1 MSA 11/12/79
REV AM 5/10/76

MECHANICAL SCHEDULE DATA
ON EXIST. DWG'S 84 & 85

MIUS FORT BELVOIR, VIRGINIA # 4430
LOAD SUMMARY TAKE-OFF DATA

WINTER LOADS

BUILDING NO.3, SERVICE MOD. A, LIVING MOD-C.D. - 1ST 2ND, 3RD FL	QUANTITY	U	ΔT °F	HTG FACTOR	TRANSM LOAD	INFILTR LOAD	VENT O.A. LOAD
WALL - NW	1511.3 #	0.20	57	11.4	17,229		
WALL - NE	1224 #	0.20	57	11.4	13,954		
WALL - SW	1224 #	0.20	57	11.4	13,954		
WALL - SE	1511.3 #	0.20	57	11.4	17,229		
GLASS - NW	277.3 #	1.13	57	64.4	17,858		
GLASS - NE	666 #	1.13	57	64.4	42,890		
△GLASS - SW	303 #	1.13	57	64.4	19,516		
GLASS - SE	381.35 #	1.13	57	64.4	24,559		
△GLASS - SW SHADED	363	1.13	57	64.4	23,380		
PE - NW	1155 #	0.19	57	10.83	1,251		
PE - NE	297 #	0.19	57	10.83	3,216		
PE - SW	297 #	0.19	57	10.83	3,216		
PE - SE	1059 #	0.19	57	10.83	1,147		
ROOF	3580 #	0.16	57	9.12	32,650		
INFILTRATION (WINTER)	1074 CFM	1.08	57	61.56		66115	
INFILTRATION (SUMMER)	1074 CFM	1.08	16				
VENTILATION (O.A.)	1500 CFM	1.08	57/16	61.56			92340
ELECTRIC (LIGHTS)							
ELECTRIC (POWER)							
PEOPLE	44						
EDGE LOSS	260 FT.			40 BTU PER FT.	10,400		
					242,449	66115	92340

SUMMER LOAD

	WALL, ROOF & GLASS ΔT	TRANS FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	SOLAR WALL & ROOF FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	SOLAR GLASS FACTOR	SOLAR GLASS LOAD BTU/HR
WALL - NW	8	1.6	2418	1	.2	302			
WALL - NE	8	1.6	1958	8	1.6	1958			
WALL - SW	8	1.6	1958	2	.4	490			
WALL - SE	8	1.6	2418	10	2.0	3023			
GLASS - NW	16	18.08	5014				40		11092
GLASS - NE	16	18.08	12041				32		21312
△GLASS - SW	16	18.08	5478				187		56661
GLASS - SE	16	18.08	6895				34		12966
△GLASS - SW SHADED	16	18.08	6563				40		14520
PE - NW	8	1.52	176	12	2.28	263			
PE - NE	8	1.52	451	12	2.28	677			
PE - SW	8	1.52	451	21	3.99	1185			
PE - SE	8	1.52	161	21	3.99	423			
ROOF	8	1.28	4582	46	7.36	26349			
			50,564			34,670			116,551

	SUMMER INFILTR SENS	SUMMER INFILTR LAT	SUMMER VENT O.A. SENS	SUMMER VENT O.A. LAT	PEOPLE SENS	PEOPLE LAT	ELECT KW	ELECT BTUH
INFILTRATION (SUMMER)	19,719	40,168						
VENTILATION (O.A.)			27540	56100				
ELECTRIC (LIGHTS)							6.96	23,734
PEOPLE					10,780	9,020		
	19,719	40,168	27,540	56,100	10,780	9,020	6.96	23734

HTG COIL CAPACITY EXISTING	EXISTING COOLING COIL CAPACITY SENS	EXISTING COOLING COIL CAPACITY LAT
(20) FC-1 @	(20) FC-1 @	(20) FC-1 @
19,000 BTUH EA	12,265 BTUH EA	4993 BTUH EA
(5) FC-2 @	(5) FC-2 @	(5) FC-2 @
13,500 BTUH EA	7,957 BTUH EA	1260 BTUH EA
(2) FC-3 @	(2) FC-3 @	(2) FC-3 @
21,000 BTUH EA	17,319 BTUH EA	2100 BTUH EA
(1) FC-4 @	(1) FC-4 @	(1) FC-4 @
18,250 BTUH EA	7,702 BTUH EA	550 BTUH EA.
(1) FC-5 @		
6,500 BTUH EA.		
414,250	329,395	20,810

NOTE:

DESIGN CALCULATIONS ARE BASED ON AUGUST 21, 2 P.M.
OUTDOOR CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITIONS 75°FDB & 50% RH.

WINTER CONDITIONS
OUTDOOR DESIGN TEMP. - +15°FDB
INDOOR CONDITIONS 72°FDB

	TOTAL HEATING LOAD	= 334789	BTU/HR
△	TOTAL SENSIBLE COOLING LOAD	= 263,839	BTU/HR
	TOTAL LATENT COOLING LOAD	= 65,120	BTU/HR
△	TOTAL COOLING LOAD	= 328,959	BTU/HR

GC 4/7/72
REV A MSA 10/12/74
REV ANI 1/75

MECHANICAL SCHEDULE DATA
ON EXIST. DWGS. 84 & 85

MIUS FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

BUILDING NO. 3 LIVING MOD: B, C, & D 1ST, 2ND & 3RD FL	QUANTITY	WINTER LOAD U	ΔT	HTG FACTOR	TRANSM LOAD	INFILTR LOAD	VENT OA	SUMMER LOAD Wall, Roof & Glass Trans ΔT	Factor	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF Solar	Factor	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS Solar	Factor	SOLAR GLASS LOAD BTU/HR
WALL - NW	2264 ¢	0.20	57	11.4	25,810			8	1.6	3622	1	.2	452			
WALL - NE	1224 ¢	0.20	57	11.4	13,954			8	1.6	1958	8	1.6	1958			
WALL - SW	1224 ¢	0.20	57	11.4	13,954			8	1.6	1958	2	.4	490			
WALL - SE	1511.30 ¢	0.20	57	11.4	17,229			8	1.6	2418	10	2.0	3022			
GLASS - NW	231 ¢	1.13	57	64.4	14,876			16	18.08	4177				40		9240
GLASS - NE	666 ¢	1.13	57	64.4	42,890			16	18.08	12,041				32		21312
△ GLASS - SW	303 ¢	1.13	57	64.4	19,516			16	18.08	5478				187		56661
GLASS - SE	231 ¢	1.13	57	64.4	14,876			16	18.08	4176				34		7854
△ GLASS - SW-SHADED	363 ¢	1.13	57	64.4	23,380			16	18.08	6563				40		14520
PE - NW	115.5 ¢	0.19	57	10.83	1,251			8	1.52	176	12	2.28	263			
PE - NE	297 ¢	0.19	57	10.83	3,216			8	1.52	451	12	2.28	677			
PE - SW	297 ¢	0.19	57	10.83	3,216			8	1.52	451	21	3.99	1185			
PE - SE	115.5 ¢	0.19	57	10.83	1,147			8	1.52	176	21	3.99	461			
ROOF	3580 ¢	0.16	57	9.12	32,650			8	1.28	4582	46	7.36	26349			
INFILTERATION (WINTER)	1074 CFM	1.08	57	61.56		66,115										
INFILTERATION (SUMMER)	1074 CFM	1.08	16													
VENTILATION (O.A.)	1440 CFM	1.08	57/16	61.56			88635									
ELECTRIC (LIGHTS)																
ELECTRIC (POWER)																
PEOPLE	48															
EDGE LOSS	278 FT			40 BTU PER FT	11,000											
					232,965	66,115	88635			48,227			32,857			109,587

BUILDING NO. 3 LIVING MOD: B, C, & D 1ST, 2ND & 3RD FL	SUMMER INFILTR SENS	LAT	SUMMER VENT O.A. SENS	LAT	PEOPLE SENS	LAT	ELECT KW	BTUH	HTG COIL CAPACITY EXISTING	EXISTING COOLING COIL CAPACITY SENS	LAT
ROOF									(24) FC-1 @	(24) FC-1 @	(24) FC-1 @
INFILTERATION (WINTER)									14,000 BTUH	12,265 BTUH	488 BTUH
INFILTERATION (SUMMER)	19,719	40,168							EA	EA	EA
VENTILATION (O.A.)			26,435	53,856					(6) FC-2 @	(6) FC-2 @	(6) FC-2 @
ELECTRIC (LIGHTS)							3.6	12,352	13,500 BTUH	7,951 BTUH	1260 BTUH
ELECTRIC (POWER)									EA	EA	EA
PEOPLE					11,760	9,840					
	19,719	40,168	26,435	53,856	11,760	9,840	3.6	12,352	417,000	361,335	19,272

NOTE:

DESIGN CALCULATIONS ARE BASED ON AUGUST 21, 2 P.M.
OUTDOOR CONDITIONS 91°FDB 77°FWB
INDOOR CONDITIONS 75°FDB & 50% RH

WINTER CONDITIONS
OUTDOOR DESIGN TEMP = +15°FDB
INDOOR CONDITIONS 72°FDB

TOTAL HEATING LOAD	=	327,585	BTU/HR
△ TOTAL SENSIBLE COOLING LOAD	=	243,218	BTU/HR
TOTAL LATENT COOLING LOAD	=	63,696	BTU/HR
△ TOTAL COOLING LOAD	=	306,914	BTU/HR

NOTE:
MECH. SCHEDULE DATA ON EXIST.
DRWGS NO. 84 & 85

Prepared by H+A
Rev △
REVISED 5-30-76 LCW

BEQ FORT BELVOIR, VIRGINIA * 4430
LOAD SUMMARY TAKE-OFF DATA

WINTER LOAD

	BLDG #4 LIVING MODULE # C&D 1ST, 2ND & 3RD FLOORS		QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFILT LOAD	VENT OA LOAD
1	WALL	NW	1511.30	.20	57	11.4	17225		
2	"	NE	1224.00	.20	57	11.4	13953		
3	"	SW	1224.00	.20	57	11.4	13953		
4	"	SE	2264.00	.20	57	11.4	25809		
5									
6	GLASS	NW	231.00	1.13	57	64.41	14876		
7	"	NE	664.00	1.13	57	64.41	42817		
8	△ "	SW	303.00	1.13	57	64.41	19516		
9	"	SE	231.00	1.13	57	64.41	14876		
10	△ 1/2 shaded	SW	363.00	1.13	57	64.41	23380		
11	P.E. PANEL	NW	115.50	.19	57	10.83	1250		
12		NE	297.00	.19	57	10.83	3216		
13		SW	297.00	.19	57	10.83	3216		
14		SE	115.50	.19	57	10.83	1250		
15	LAT LOAD FACTOR (96-68)		37.9						
16	ROOF		3580.00	.16	57	9.12	32650		
17	EDGE LOSS (W/LIN FT)		275.00				11000		
18	INFILT (SUMMER) .75 AC		10740.00						
19	VENT O.A.		1940.00						88635
20	ELECT (LIGHT) KW		36.00						
21	ELECT (POWER) KW		6.00						
22	PEOPLE 205/245		48.00						
23	INFILT (WINTER) .5 AC		10740.00					66116	
24	CLG COIL CAP								
25	HTG COIL CAP								
26	TOTALS						234068	66116	88635

SUMMER LOAD

	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
1	8	1.6	2418	1	.2	3022			
2	8	1.6	1958	8	1.6	1958			
3	8	1.6	1958	2	.4	490			
4	8	1.6	3622	10	2.0	4528			
6	16	18.1	4181				40		9240
7	16	18.1	12054				32		21312
8	16	18.1	5484				187		56661
9	16	18.1	4181				34		7854
10	16	18.1	6570				40		14520
11	8	1.5	174	12	2.28	264			
12	8	1.5	446	12	2.28	677			
13	8	1.5	446	24	4.0	1188			
14	8	1.5	174	21	4.0	464			
16	8	1.3	4654	46	7.4	26492			
26 TOTALS			48320			39083			109587

	SUMMER INFILT SENS	SUMMER INFILT LAT	SUMMER VENT SENS	SUMMER VENT LAT	PEOPLE SENS	PEOPLE LAT	ELECT KW	ELECT BTUH	HTG COIL CAP	CLG COIL CAP SENS	CLG COIL CAP LAT
1									[illegible]	[illegible]	[illegible]
2									[illegible]	[illegible]	[illegible]
18	19703	40167									
19			26435	53856							
20							360	12286			
22					11760	9840					
24										342066	[illegible]
25									417000		
26 TOTALS	19703	40167	26435	53856	11760	9840	360	12286	417000	342066	[illegible]

NOTE
DESIGN CALCULATIONS ARE BASED ON AUGUST 21, @ 2 P.M.

OUTDOOR CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITIONS 75°FDB & 50% RH

WINTER CONDITIONS
OUTDOOR DESIGN TEMP = +15°F
INDOOR CONDITION 72°FDB.

	TOTAL HEATING LOAD	= 327,703 BTU/HR
△	TOTAL SENSIBLE COOLING LOAD	= 247,471 BTU/HR
	TOTAL LATENT COOLING LOAD	= 63,696 BTU/HR
△	TOTAL COOLING LOAD	= 311,167 BTU/HR

NOTE:
MECH. SCHEDULE DATA ON EXIST.
DRWGS. NO. 54485

Prepared by USA [illegible]
Approved by
REV △ USA [illegible]
REVISED 5-20-76 LCW

BEQ FORT BELVOIR, VIRGINIA, # 6630
LOAD SUMMARY TAKE-OFF DATA

BLDG #4 LIVING MODULE B, C & D 1st, 2nd & 3rd FLOORS		QUANTITY	WINTER LOAD U	ΔT	HTG FACTOR	TRANS LOAD	INFILT LOAD	VENT O.A. LOAD
WALL	NW	1264.00	.20	57	11.4	25891		
"	NE	1224.00	.20	57	11.4	13953		
"	SW	1224.00	.20	57	11.4	13953		
"	SE	1511.30	.20	57	11.4	17235		
GLASS	NW	231.00	1.13	57	64.41	14876		
"	NE	666.00	1.13	57	64.41	42897		
△ "	SW	303.00	1.13	57	64.41	19516		
"	SE	231.00	1.13	57	64.41	14876		
△ " Shaded	SW	363.00	1.13	57	64.41	23380		
P-E PANEL	NW	115.50	.19	57	10.83	1250		
"	NE	297.00	.19	57	10.83	3216		
"	SW	297.00	.19	57	10.83	3216		
"	SE	115.50	.19	57	10.83	1250		
LAT LOAD FACTOR (GR. LB)		37.9						
ROOF		3580.00	.16	57	9.12	32650		
EDGE LOSS (ABSTN)(FT.)		875.00				11800		
INFILT. (Summer) SCFM (SAW) (ODNT)		1674.00						
VENT O.A.		1440.00						88635
ELECT (LIGHT) KW		36.0						
ELECT. (POWER) KW		5.00						
PEOPLE 205/245		48.00						
INFILT (WINTER) SCFM		1074.00					66116	
CLG COIL CAP								
HTG COIL CAP								
TOTALS						239068	66116	88635

SUMMER LOAD WALL, ROOF & GLASS TRANS. ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
8	1.6	3622	1	.2	453			
8	1.6	1958	8	1.6	1958			
8	1.6	1958	2	.4	490			
8	1.6	2418	10	2.0	3022			
16	18.1	4181				40		9240
16	18.1	12054				32		21312
16	18.1	5484				187		56661
16	18.1	4181				34		7854
16	18.1	6570				40		14520
8	1.5	174	12	2.28	264			
8	1.5	446	12	2.28	677			
8	1.5	446	21	4.0	1188			
8	1.5	174	21	4.0	464			
8	1.3	4654	46	7.4	26492			
TOTALS		48320			35008			109587

	SUMMER INFILT SENS	SUMMER INFILT LAT	SUMMER VENT SENS	SUMMER VENT LAT	PEOPLE SENS	PEOPLE LAT	ELECT. KW	ELECT. BTU/HR	HTG COIL CAP	CLG COIL CAP SENS	CLG COIL CAP LAT
									[illegible]	13365	[illegible]
									[illegible]	7991	[illegible]
INFILT. (Summer)	19709	40167									
VENT O.A.			26435	53856							
ELECT (LIGHT)							360	12286			
PEOPLE					11760	4840					
CLG COIL CAP										343066	[illegible]
HTG COIL CAP									417000		
TOTALS	19709	40167	26435	53856	11760	4840	36	12286	417000	343066	[illegible]

DESIGN CALCULATIONS ARE BASED ON AUGUST 21 AT 2 P.M.

OUTDOOR CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITIONS 75°FDB & 50% RH

WINTER CONDITIONS
OUTDOOR DESIGN TEMP = +15°F
INDOOR CONDITION 72°F

TOTAL HEATING LOAD = 327,703 BTU/HR
△ TOTAL SENSIBLE COOLING LOAD = 243,396 BTU/HR
TOTAL LATENT COOLING LOAD = 63,696 BTU/HR
△ TOTAL COOLING LOAD = 307,092 BTU/HR

NOTE:
MECH SCHEDULE DATA ON EXIST DRWGS. NO. 84 & 85

REVISED 5-20-76 LCW

BEQ. FORT BELVOIR, VIRGINIA # 4490
LOAD SUMMAR TAKE-OFF

BLDG #4
SERVAL IN MODULE A.C.&D
1ST, 2ND & 3RD FLOORS

		Quantity	WINTER LOAD U	ΔT	HTG Factor	Trans Load	Infilt Load	Vent O.A Load	SUMMER LOAD Wall, Roof & Glass Trans ΔT	Factor	Transm Load BTU/HR	Solar Wall & Roof Solar	Factor	Solar Wall & Roof Load BTU/HR	Solar Glass Solar	Factor	Solar Glass Load BTU/HR
WALL	NW	1511.30	.20	57	11.4	17228			8	1.6	2418	1	.2	3022			
"	NE	1224.00	.20	57	11.4	13953			8	1.6	1958	8	1.6	1958			
"	SW	1224.00	.20	57	11.4	13953			8	1.6	1958	2	.4	490			
"	SE	1511.30	.20	57	11.4	17228			8	1.6	2418	10	2.0	3022			
GLASS	NW	173.05	1.13	57	64.41	11157			16	18.1	3131				40		6920
"	NE	666.00	1.13	57	64.41	42897			16	18.1	12054				32		21312
⚠ "	SW	303.00	1.13	57	64.41	19516			16	18.1	5484				187		56661
"	SE	485.00	1.13	57	64.41	31239			16	18.1	8779				34		16490
⚠ " Shaded	SW	363.00	1.13	57	64.41	23380			16	18.1	6570				40		14520
R-PANEL	NW	86.00	.19	57	10.83	931			8	1.5	129	12	2.28	196			
"	NE	297.00	.19	57	10.83	3216			8	1.5	446	12	2.28	677			
"	SW	297.00	.19	57	10.83	3216			8	1.5	446	21	4.0	1188			
"	SE	115.56	.19	57	10.83	1250			8	1.5	174	21	4.0	464			
LAT. LOAD FACTOR (85 x 68)		37.4															
ROOF		3580.00	.16	57	9.12	32650			8	1.3	4654	46	7.4	26492			
EDGE LOSS (40 BTU/H/LF)		260.00				10400											
INFILT. (SUMMER) .75 AC		1074.00															
VENT. O A		1500.00						92340									
ELECT. (LIGHT) KW		696															
ELECT. (POWER) KW		12.21															
PEOPLE 205/245		44.00															
INFILT. (WINTER) .75 AC		1074.00					66116										
CLG COIL CAP																	
HTG COIL CAP																	
TOTALS						149210	66116	92340			50621			37509			115803

	Summer Infilt Sens	Summer Infilt Lat	Summer Vent Sens	Summer Vent Lat	People Sens	People Lat	Elect KW	Elect BTUH	HTG Coil Cap	CLG Coil Cap Sens	CLG Coil Cap Lat
WALL – SE									[illegible]	[illegible]	[illegible]
INFILT. (SUMMER) .75 AC	19703	40167									
VENT. O A			27540	56700							
ELECT. (LIGHT) KW							696	23755			
PEOPLE 205/245					10780	9020					
CLG COIL CAP										[illegible]	230810
HTG COIL CAP									414250		
TOTALS	19703	40167	27540	56700	10780	9020	696	23755	414250	[illegible]	230810

NOTE.
DESIGN CALCULATIONS ARE BASED UPON AUGUST 21, AT 2PM
OUTDOOR CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITION 75°FDB & 50% RH

WINTER CONDITIONS
OUTDOOR DESIGN TEMP = +15°FDB.
INDOOR CONDITION 72°FDB

	TOTAL HEATING LOAD	= 334550 BTU/HR
⚠	TOTAL SENSIBLE COOLING LOAD	= 266108 BTU/HR
	TOTAL LATENT COOLING LOAD	= 65420 BTU/HR
⚠	TOTAL COOLING LOAD	= 331528 BTU/HR

NOTE
MECH SCHEDULE DATA ON EXIST.
DRWGS. NO. 84 & 85

Prepared by MSA [illegible]
Rev. △ MCA [illegible]
Rev. AM 1/20/76

BEQ FORT BELVOIR, VIRGINIA # 4450
LOAD SUMMARY TAKE OFF DATA.

BLDG # 5 (8 SIMILAR LIV. MODULES) LIVING MODULE B, C & D 1ST, 2ND & 3RD FLOORS		QUANTITY	WINTER LOAD U	ΔT	HTG FACTOR	TRANS. LOAD	INFILT LOAD	VENT O.A. LOAD	SUMMER LOAD WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR.	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	1511.30	.20	57	11.4	17229			8	1.6	2418	1	.2	302			
"	NE	1224.00	.20	57	11.4	13953			8	1.6	1958	8	1.6	1958			
"	SW	1224.00	.20	57	11.4	13953			8	1.6	1958	2	.4	490			
"	SE	1511.30	.20	57	11.4	17229			8	1.6	2418	10	2.0	3023			
GLASS	NW	381.75	1.13	57	64.41	24563			16	18.08	6895				40		15254
"	NE	666.00	1.13	57	64.41	42897			16	18.08	12041				32		21312
△ "	SW	303.00	1.13	57	64.41	19516			16	18.08	5478				187		56661
"	SE	192.50	1.13	57	64.41	12399			16	18.08	3480				34		6545
△ " Shaded	SW	363.00	1.13	57	64.41	23380			16	18.08	6563				40		14520
P.E. PANEL	NW	105.87	.19	57	10.83	1147			8	1.52	161	12	2.28	241			
"	NE	297.00	.19	57	10.83	3216			8	1.52	451	12	2.28	677			
"	SW	297.00	.19	57	10.83	3216			8	1.52	451	21	3.99	1185			
"	SE	96.25	.19	57	10.83	1043			8	1.52	146	21	3.99	384			
LAT. LOAD FACTOR (SS.[illegible])		37.40															
ROOF		3580.00	.16	57	9.12	32650			8	1.28	4582	46	7.36	26349			
EDGE LOSS (40 BTUH/FT)		275.00				11000											
INFILT (Summer)		1074.00															
VENT. O.A. (Summer/Winter)		1440.00						88635									
ELECT. (LIGHT) KW		3.60															
ELECT. (POWER) KW		11.10															
PEOPLE 205/245		48.00															
INFILT. (Winter)		1074.00					66116										
CLG COIL CAP																	
HTG COIL CAP.																	
TOTALS						237992	66116	88635			49,000			34,609			114292

BLDG # 5	TOTAL GLASS LOAD	SUMMER INFILT SENS.	LAT.	SUMMER VENT SENS	LAT	PEOPLE SENS	LAT	ELECT. KW	BTUH	HTG COIL CAP.	CLG COIL CAP. SENS	LAT.
WALL NW										[illegible] @ [illegible]	18265	488
WALL NE										[illegible] @ [illegible]	3951	1800
INFILT (Summer)		14703	40167									
VENT. O.A.				20435	53854							
ELECT. (LIGHT) KW								3.6	12286			
PEOPLE						11760	9840					
CLG COIL CAP											342066	19872
HTG COIL CAP.										417000		
TOTALS	9	14703	40167	20435	53854	11760	9840	3.6	12,286	417000	342066	19872

NOTE
DESIGN CALCULATIONS ARE BASED UPON AUG 21, AT 2 P.M. OUTDOOR CONDITIONS 91°FDB, 77°FWB INDOOR CONDITIONS 75°FDB, 50% RH WINTER CONDITIONS OUTDOOR DESIGN TEMP = +18°FDB INDOOR CONDITION 75°FDB

	TOTAL HEATING LOAD	=	326,027 BTUH
△	TOTAL SENSIBLE COOLING LOAD	=	248,382 "
	TOTAL LATENT COOLING LOAD	=	63,694 "
△	TOTAL COOLING LOAD	=	312,076 "

NOTE
MECH SCHEDULE DATA 3.1 EXIST.
DRWGS NO #4 & #5

Prepared by MSA 1/16/74
Rev △ MSA 4/16/74
Rev #78 1/20/76

BEQ FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

BLDG #5
[illegible] MODULE [illegible]
1ST, 2ND & 3RD FLOORS

WINTER LOAD

	Item		Quantity	U	ΔT	HTG Factor	Trans Load	Infilt Load	Vent O.A. Load
1	WALL	NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
2	"	NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
3	"	SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
4	"	SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
5									
6	GLASS	NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
7	"	NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
8	△ "	SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
9	"	SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
10	△ " Shaded	SW	[illegible]	1.13	57	[illegible]	23380		
11	P.E. PANEL	NW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
12	"	NE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
13	"	SW	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
14	"	SE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
15	LALIMO FACING (89 x 60)		324						
16	ROOF		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
17	EDGE LOSS (40 Btuh/FT)		[illegible]				[illegible]		
18	INFILT. (Summer)		[illegible]						
19	VENT. O.A.		[illegible]						93340
20	ELECT (LIGHT) KW		6.96						
21	ELECT. (POWER) KW		[illegible]						
22	PEOPLE 195/245		44.00						
23	INFILT. (Winter)		[illegible]					66116	
24	CLG. COIL CAP.								
25	HTG COIL CAP.								
26	TOTALS						246796	66116	93340

SUMMER LOAD

	Item		Wall, Roof & Glass Trans ΔT	Factor	Transm Load BTU/HR	Solar Wall & Roof Solar	Factor	Solar Wall & Roof Load BTU/HR	Solar Glass Solar	Factor	Solar Glass Load BTU/HR
1	WALL	NW	8	1.6	3622	1	.2	453			
2	"	NE	8	1.6	1958	8	1.6	1958			
3	"	SW	8	1.6	1958	2	.4	490			
4	"	SE	8	1.6	2120	10	2.0	3524			
5											
6	GLASS	NW	16	18.05	4177				40		9240
7	"	NE	16	18.05	12841				32		21312
8	△ "	SW	16	18.05	5478				187		56641
9	"	SE	16	18.05	5710				34		10737
10	△ " Shaded	SW	16	18.08	6563				40		14520
11	P.E. PANEL	NW	8	1.52	176	12	2.28	263			
12	"	NE	8	1.52	451	12	2.28	677			
13	"	SW	8	1.52	451	21	3.99	1185			
14	"	SE	8	1.52	176	21	3.99	461			
16	ROOF		8	1.28	4582	46	7.36	26349			
26	TOTALS				50,163			35,360			112,470

	Item		Total Glass Load	Summer Infilt Sens.	Summer Infilt Lat.	Summer Vent Sens	Summer Vent Lat.	People Sens.	People Lat.	Elect. KW	Elect. BTUH	HTG Coil Cap	CLG Coil Cap Sens.	CLG Coil Cap Lat.
1	WALL	NW										[illegible]	13865	480
2	"	NE										[illegible]	19357	1260
3	"	SW										[illegible]	17319	2100
4	"	SE										[illegible]	9702	950
5												[illegible]	—	—
18	INFILT. (Summer)			19707	40167									
19	VENT. O.A.					27540	56400							
20	ELECT (LIGHT) KW									6.96	23755			
22	PEOPLE 195/245							10780	9080					
24	CLG. COIL CAP.												384395	20810
25	HTG COIL CAP.											414250		
26	TOTALS			19707	40167	27540	56400	10780	9080	6.96	23,755	414250	484395	20810

NOTE
DESIGN CALCULATIONS ARE BASED UPON AUG 21, AT 2 P.M.
OUTDOOR CONDITIONS 91°F DB, 77°F WB
INDOOR CONDITIONS 75°F DB, 40% RH
WINTER CONDITIONS OUTDOOR DESIGN TEMP = +15°F DB
INDOOR CONDITION 72°F DB

TOTAL HEATING LOAD = 339,136 BTUH
△ TOTAL SENSIBLE COOLING LOAD = 260,068 "
TOTAL LATENT COOLING LOAD = 65,480 "
△ TOTAL COOLING LOAD = 325,488 "

BFQ. FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

Prepared by USA [illegible]
REV ⚠ WCA [illegible]
REV [illegible] 5/20/76

NOTE:
MECH SCHEDULE DATA ON EXIST.
DRWGS. NO. 84 & 85

BLDG #5 Security Module A, C & D 1ST, 2ND & 3RD FLOORS		QUANTITY	WINTER LOAD U	ΔT	HTG FACTOR	TRANS LOAD	INFILT LOAD	VENT O.A. LOAD	SUMMER LOAD WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	1511.30	.20	57	11.4	17228			8	1.6	2418	1	.2	302			
"	NE	1224.00	.20	57	11.4	13953			8	1.6	1958	8	1.6	1958			
"	SW	1224.00	.20	57	11.4	13953			8	1.6	1958	2	.4	490			
"	SE	2013.00	.20	57	11.4	22948			8	1.6	3220	10	2.0	4026			
GLASS	NW	231.00	1.13	57	64.41	14876			16	18.08	4177				40		9240
"	NE	666.00	1.13	57	64.41	42897			16	18.08	12041				32		21312
⚠ "	SW	303.00	1.13	57	64.41	19516			16	18.08	5478				187		56661
"	SE	315.00	1.13	57	64.41	20340			16	18.08	5710				34		10737
⚠ " Shaded	SW	363.00	1.13	57	64.41	23380			16	18.08	6563				40		14520
PE PANEL	NW	115.50	.19	57	10.83	1250			8	1.52	176	12	2.28	263			
"	NE	297.00	.19	57	10.83	3216			8	1.52	451	12	2.28	677			
"	SW	297.00	.19	57	10.83	3216			8	1.52	451	21	3.99	1185			
"	SE	115.50	.19	57	10.83	1250			8	1.52	176	21	3.99	461			
LAT. HEAT FACTOR (5% - 48)		37.4															
ROOF		3580.00	.16	57	9.12	32650			8	1.28	4582	46	7.36	26349			
EDGE LOSS (40 BTU/LF)		260.00				10400											
INFILT. (Summer) .75 CFM		1074.00															
VENT. O.A.		1500.00						92740									
ELECT. (LIGHT) KW		696															
ELECT. (POWER) KW		460															
PEOPLE 205/245		44.00															
INFILT. (Winter) 1.5		1432.00					66116										
CLG. COIL CAP																	
HTG. COIL CAP.																	
TOTALS						241074	66116	92340			49359			35711			112,470

BLDG #5		TOTAL GLASS LOAD	SUMMER INFILT SENS	LAT.	SUMMER VENT SENS	LAT.	PEOPLE SENS	LAT.	ELECT KW	BTUH	HTG COIL CAP	CLG COIL CAP SENS	LAT.
WALL	NW										[illegible]	13265	488
"	NE										[illegible]	7451	1360
"	SW										[illegible]	17319	2100
"	SE										[illegible]	4702	650
GLASS	NW										[illegible]		
INFILT. (Summer)			19703	40167									
VENT. O.A.					27540	56400							
ELECT. (LIGHT)									6.96	23755			
PEOPLE							10780	4080					
CLG. COIL CAP												[illegible]	20810
HTG. COIL CAP.											414250		
TOTALS			19703	40167	27540	56400	10780	4080	6.96	23755	414250	[illegible]	20810

NOTE:
DESIGN CALCULATIONS ARE BASED UPON AUG 21, AT 2 P.M.
OUTDOOR CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITIONS 75°FDB, 50% RH
WINTER CONDITIONS
OUTDOOR DESIGN TEMP. = 15°FDB
INDOOR CONDITION 72°FDB

	TOTAL HEATING LOAD	= 393,414 BTUH
⚠	TOTAL SENSIBLE COOLING LOAD	= 259,617 "
	TOTAL LATENT COOLING LOAD	= 65,420 "
⚠	TOTAL COOLING LOAD	= 325,037 "

BEQ. FORT BELVOIR, VIRGINIA # 4430
LOAD SUMMARY TAKE-OFF DATA

Initials Date
Prepared by MFA 12/5/74
Approved by
Rev. △ MFA 12/18/74
(Rev. Rev. △) MFA 12/16/74
REVISED 5-20-76 LCW

NOTE
MECH. SCHEDULE DATA ON LIST
DWGS. NO. 84 & 85

WINTER LOAD / SUMMER LOAD

BLDG. # G SERVICE MODULE A/CAD 1st, 2nd & 3rd FLOORS		QUANTITY	U	ΔT	HTG. FACTOR	TRANS. LOAD	INFIL. LOAD	VENT. O.A. LOAD	WALL, ROOF & GLASS TRANS. ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	1811.30	.20	57	11.4	17938			8	1.6	2418	1	.2	302			
"	NE	1224.00	.20	57	11.4	13951			8	1.6	1958	8	1.6	1958			
"	SW	1224.00	.20	57	11.4	13953			8	1.6	1958	2	.4	490			
"	SE	2013.00	.20	57	11.4	22948			8	1.6	3220	10	2.0	4026			
GLASS	NW	231.00	1.13	57	64.41	14826			16	18.1	4181				40		9240
"	NE	665.00	1.13	57	64.41	42841			16	18.1	12054				32		21312
△ "	SW	303.00	1.13	57	64.41	19516			16	18.1	5484				187		56661
"	SE	315.80	1.13	57	64.41	20340			16	18.1	5720				34		10744
△ " Shaded	SW	363.00	1.13	57	64.41	23380			16	18.1	6570				40		14520
P.E PANEL	NW	115.40	.19	57	10.83	1250			8	1.5	174	12	2.28	264			
"	NE	297.00	.19	57	10.83	3216			8	1.5	446	12	2.28	677			
"	SW	297.00	.19	57	10.83	3216			8	1.5	446	21	4.0	1188			
"	SE	115.40	.19	57	10.83	1250			8	1.5	174	21	4.0	460			
LAT. LOAD FACTOR (SG.-LG)		37.4															
ROOF		3580.00	.16	57	9.12	32650			8	1.3	4654	46	7.4	26492			
EDGE LOSS (40 BTUH/FT.)		260.00				10400											
INFILT. (.75AC/HR) SEE IT. LOAD		1074.00					66116										
VENT. O.A.		1500.00						92340									
ELECT. (LIGHT) KW		6.96															
ELECT. (POWER) KW		4.00															
PEOPLE 205/245		44.00															
CLG. COIL CAP.																	
HTG. COIL CAP.																	
TOTALS						241074	66116	92340			49457			35857			112477

	SUMMER INFIL. SENS.	LAT.	SUMMER VENT SENS.	LAT.	PEOPLE SENS.	LAT.	ELECT. KW	BTU/HR	HTG. COIL CAP.	CLG. COIL CAP. SENS.	LAT.
									[illegible]	12866	488
									[illegible]	7951	1860
									[illegible]	17919	2100
									[illegible]	9702	550
									[illegible]	—	—
INFILT.	11703	40167									
VENT. O.A.			27540	56100							
ELECT. (LIGHT)							6.96	23755			
PEOPLE					10780	9020					
CLG. COIL CAP.										328345	20080
HTG. COIL CAP.									414250		
TOTALS	11703	40167	27540	56100	10780	9020	6.96	23755	414250	328345	20080

	TOTAL HEATING LOAD	= 393,414 BT
△	TOTAL SENSIBLE COOLING LOAD	= 259,866 "
	TOTAL LATENT COOLING LOAD	= 65,220 "
△	TOTAL COOLING LOAD	= 325,086

NOTE
DESIGN CALCULATIONS ARE BASED UPON AUGUST 21, AT 2PM
OUTDOOR CONDITIONS 91°FDB, 77°FWB
INDOOR CONDITIONS 75°FDB & 50% RH
WINTER CONDITIONS
OUTDOOR DESIGN TEMP = + 15°FDB
INDOOR CONDITION 72°FDB.

NOTE:
MECH SCHEDULE DATA ON EXIST.
DWGS NO B4 & B5

REVISED 5-20-76 LCW

BLDG. FORT BELVOIR, VIRGINIA #4930
LOAD SUMMARY TAKE-OFF DATA

WINTER LOAD

BLDG #6 LIVING/WORK A.C.&D 1st, 2nd & 3rd FLOORS		QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFILT LOAD	VENT O.A. LOAD
WALL	NW	1511.30	.20	57	11.4	17228		
"	NE	1224.00	.20	57	11.4	13953		
"	SW	1274.00	.20	57	11.4	14523		
"	SE	1511.30	.20	57	11.4	17229		
GLASS	NW	381.45	1.13	57	64.41	24569		
"	NE	666.00	1.13	57	64.41	42897		
△ "	SW	908.00	1.13	57	64.41	14516		
"	SE	192.50	1.13	57	64.41	12399		
△ Shaded	SW	369.00	1.13	57	64.41	23780		
P-E PANEL	NW	105.87	.19	57	10.83	1147		
"	NE	297.00	.19	57	10.83	3216		
"	SW	297.00	.19	57	10.83	3216		
"	SE	96.25	.19	57	10.83	1043		
SAT LOAD FACTOR (95° - 60°)		37.9						
ROOF		3580.00	.16	57	9.12	32650		
EDGE LOSS (40 BTU/H/FT)		275.00				11000		
INFILT (SUMMER) (1/2 AC/HR)		1074.00						
VENT. O.A. (CONTINUOUS)		1440.00						88635
ELECT. (LIGHT) KW		3.60						
ELECT. (POWER) KW		11.10						
PEOPLE 204/245		48.00						
INFILT (WINTER) 1 AC/HR		1074.00					66116	
CLG. COIL CAP.								
HTG. COIL CAP.								
TOTALS						237392	66116	88635

SUMMER LOAD

		WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	8	1.6	2418	1	.2	302			
"	NE	8	1.6	1958	8	1.6	1958			
"	SW	8	1.6	1958	2	.4	490			
"	SE	8	1.6	2418	10	2.0	3022			
GLASS	NW	16	18.1	6906				40		15240
"	NE	16	18.1	12055				32		21312
△ "	SW	16	18.1	5484				187		56661
"	SE	16	18.1	3493				34		6562
△ Shaded	SW	16	18.1	6570				40		14520
P-E PANEL	NW	8	1.5	159	12	2.28	242			
"	NE	8	1.5	446	12	2.28	677			
"	SW	8	1.5	446	21	4.0	1188			
"	SE	8	1.5	144	21	4.0	384			
ROOF		8	1.3	4654	46	7.4				
TOTALS				49099			8263			114295

LOAD SUMMARY

	SUMMER INFILT SENS	SUMMER INFILT LAT	SUMMER VENT SENS	SUMMER VENT LAT	PEOPLE SENS	PEOPLE LAT	ELECT. KW	ELECT. BTU/H	HTG COIL CAP	CLG COIL CAP SENS	CLG COIL CAP LAT
WALL NW									[illegible]	12265	488
WALL NE									[illegible]	7931	3260
INFILT (SUMMER)	14707	40167									
VENT. O.A.			26485	53856							
ELECT.							360	12286			
PEOPLE					11760	4840					
CLG. COIL CAP.										320066	19878
HTG. COIL CAP.									417000		
TOTALS	14707	40167	26485	53856	11760	4840	360	12286	413000	342066	19872

NOTE

DESIGN CALCULATIONS ARE BASED UPON AUGUST 21, AT 2 PM.

OUTDOOR CONDITIONS
91°F DB, 77°F WB
INDOOR CONDITIONS
75°F DB, & 50% RH

WINTER CONDITIONS
OUTDOOR DESIGN
TEMP = +15°F DB
INDOOR CONDITION
72°F DB

	TOTAL HEATING LOAD	= 326,027 BTU/HR
△	TOTAL SENSIBLE COOLING LOAD	= 222,138 BTU/HR
	TOTAL LATENT COOLING LOAD	= 63,696 BTU/HR
△	TOTAL COOLING LOAD	= 285,834 BTU/HR

Initials Date
Prepared by MCA 12/4/74
Approved by
REVISED 5-19-76 LCW

NOTE
MECH. SCHEDULE DATA ON EXIST.
DRWGS NO. 242

BED. FORT BELVOIR, VIRGINIA # 0430
LOAD SUMMARY TAKE-OFF DATA

WINTER LOAD

GROUP DISPENSARY #7 BLDG		QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFILT LOAD	VENT OA LOAD
WALL	NW	282	.20	57	11.4	3211		
"	NE	662	.20	57	11.4	7546		
"	SW	642	.20	57	11.4	7318		
"	SE	313	.20	57	11.4	3568		
GLASS	NW	84	1.13	57	64.41	5410		
"	NE	114	1.13	57	64.41	7343		
"	SW	166	1.13	57	64.41	10692		
"	SE	43	1.13	57	64.41	2769		
P.E. PANEL	NW	35	.19	57	10.83	379		
LAT. LOAD FACTOR (55 x 68)		3740						
ROOF		3195	.16	57	9.12	29138		
EDGE LOSS (LIN. FT.)		275				11000		
INFILT (Summer) 75AC (summer only)		348						
VENT. OA		510						31396
ELECT. (LIGHT) KW		7.9						
ELECT (POWER) KW		3.8						
PEOPLE 205/245		10						
INFILT (Winter) .75AC		348					21423	
CLG COIL CAP								
HTG COIL CAP								
TOTALS						88377	21423	31396

SUMMER LOAD

GROUP DISPENSARY #7 BLDG		WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	8	1.6	451	1	.2	56			
"	NE	8	1.6	1059	8	1.6	1059			
"	SW	8	1.6	1027	2	.4	257			
"	SE	8	1.6	501	10	2.0	626			
GLASS	NW	16	18.1	1520				40		3360
"	NE	16	18.1	2063				32		3648
"	SW	16	18.1	3005				187		31042
"	SE	16	18.1	778				34		1462
P.E. PANEL	NW	8	1.5	53	12	2.3	81			
ROOF		8	1.3	4154	46	7.4	23643			
TOTALS				14611			25722			39512

GROUP DISPENSARY #7 BLDG	SUMMER INFILT SEN	SUMMER INFILT LAT	SUMMER VENT SEN	SUMMER VENT LAT	PEOPLE SENS	PEOPLE LAT	ELECT KW	ELECT BTUH	HTG COIL CAP	CLG COIL CAP SENS	CLG COIL CAP LAT
INFILT (Summer) 75AC	6390	13015									
VENT. OA			4964	19074							
ELECT. (LIGHT) KW							7.9	26962			
PEOPLE 205/245					2050	2450					
CLG COIL CAP										104402	24939
HTG COIL CAP									250000		
TOTALS	6390	13015	4964	19074	2050	2450	7.9	26962	250000	104402	24939

NOTE
DESIGN CALCULATIONS
ARE BASED UPON
AUG 21 AT 2 P.M.
OUTDOOR CONDITIONS
91°FDB, 77°FWB
INDOOR CONDITIONS
76°FDB, 50% RH
WINTER CONDITIONS
OUTDOOR DESIGN
TEMP = +15°FDB
INDOOR CONDITION
70°FDB

TOTAL HEATING LOAD = 119,779 BTU
TOTAL SENSIBLE COOLING LOAD = 118221
TOTAL LATENT COOLING LOAD = 21,524
TOTAL COOLING LOAD = 139,745

Prepared by MSA 4/4/76
Approved by
✓ REVISED 5-20-76 LCW

BEN. FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

NOTE:
MECH. SCHEDULE DATA ON EXIST DRWGS. NO. 225 & 226

WINTER LOAD

BRANCH EXCHANGE		QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFIL LOAD	VENT OA LOAD
#8 BLDG								
WALL	NW	710	.20	57	11.4	8094		
"	NE	400	.20	57	11.4	4560		
"	SW	610	.20	57	11.4	6954		
"	SE	640	.20	57	11.4	7296		
GLASS	NW	220	1.13	57	64.41	14170		
"	SW	160	1.13	57	64.41	9864		
"	SE	300	1.13	57	64.41	19323		
LAT LOAD FACTOR (45 GR)		17.40						
ROOF		4720	.16	57	9.69	45796		
EDGE LOSS (40 BTUH/FT)		410				16400		
INFILT (.75 AC/HR) 1.08×17		348					21422	
VENT OA		2660						163749
ELECT (LIGHT) KW		17.8						
ELECT (POWER) KW		64.9						
PEOPLE 205/245		50						
CLG. COIL CAP								
HTG. COIL CAP.								
TOTALS						122397	21422	163794

SUMMER LOAD

		WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	8	1.6	1136	1	.2	142			
"	NE	8	1.6	640	8	1.6	640			
"	SW	8	1.6	976	2	.4	244			
"	SE	8	1.6	1024	10	2.0	1280			
GLASS	NW	16	18.1	3982				40		8800
"	SW	16	18.1	2896				187		11220
"	SE	16	18.1	5430				34		10200
ROOF		8	1.3	6136	46	7.4	34928			
TOTALS				20410			37234			30220

	SUMMER INFILT SENS	LAT	SUMMER VENT SENS	LAT	PEOPLE SENS	LAT	ELECT KW	BTUH	HTG COIL CAP	CLG COIL CAP SENS	LAT
INFILT	6389	13015									
VENT OA			48837	84524							
ELECT							123	59044			
PEOPLE					10250	2250					
CLG. COIL CAP										347,608	61,136
HTG. COIL CAP.									413000		
TOTALS	6389	13015	48837	84524	10250	2250	123	59044	413000*	347,608	61,136

*ASSUMING 36°F HTG ΔT

TOTAL HEATING LOAD	=	286,191	BTU/HR
TOTAL SENSIBLE COOLING LOAD	=	205,995	" "
TOTAL LATENT COOLING LOAD	=	96,114	" "
TOTAL COOLING LOAD	=	302,769	"

NOTE:
DESIGN CALCULATIONS ARE BASED UPON AUG 21, AT 2 P.M
OUTDOOR CONDITIONS 91°F DB, 77°F WB
INDOOR CONDITION 75°F DB, 50% RH
WINTER CONDITIONS
OUTDOOR DESIGN TEMP. = +15°F DB
INDOOR CONDITION 72°F DB

NOTE
MECH. SCHEDULE DATA ON EXIST. DWGS. NO. 190 & 191

REVISED 5-19-76 LCW
✓REVISED 5/27/76 SO

BEQ. FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

#9 BLDG
3 Co. ADMINIST. BLDG. #1 OFFICES

WINTER LOAD

	QUANTITY	U	ΔT	HTG. FACTOR	TRANS. LOAD	INFILT. LD.	VENT O.A LD.
WALL (PARTITION) I.W	1752	.34	0	—	—		
" NE	426	.2	47	11.4	4856		
" SW	426	.2	47	11.4	4856		
" SE	1134	.2	47	11.4	12928		
GLASS SE	346	1.13	47	64.41	22282		
P.E. PANEL SE	126	.19	47	10.83	1361		
ROOF	5402	.16	47	9.12	49266		
EDGE LOSS (40 BTUH/LF)	218			40	8720		
INFILT. (.75 AC/HR)	543					13427	
VENT. O.A	600						36936
ELECT. (LIGHT) W	18180						
ELECT. (POWER) KW	2.83						
PEOPLE (205/245)	45						
SENS. FACTOR 1.08x17x18.96							
LAT. FACTOR 35x.68x37.4							
CLG. COIL CAP.							
HTG. COIL CAP.							
TOTALS					104269	13427	36936

SUMMER LOAD

	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL (PARTITION) I.W	16	5.4	9461	—	—	—			
" NE	8	1.6	682	8	1.6	682			
" SW	8	1.6	682	2	.4	170			
" SE	8	1.6	1814	10	2.0	2268			
GLASS SE	16	18.1	6263				34		11764
P.E. PANEL SE	8	1.5	189	21	4.0	504			
ROOF	8	1.3	7023	46	7.4	39975			
TOTALS			26114			43599			11764

	SUMMER INFILT. SENS	SUMMER INFILT. LAT.	SUMMER VENT. SENS	SUMMER VENT. LAT.	PEOPLE SENS	PEOPLE LAT.	ELECT. KW	ELECT. BTUH	HTG COIL CAP.	CLG. COIL CAP. SENS	CLG. COIL CAP. LAT.
INFILT. (.75 AC/HR)	9969	20308									
VENT. O.A			11016	23440							
ELECT. (LIGHT) W								61812			
PEOPLE (205/245)					9225	11025					
CLG. COIL CAP.										117864	42138
HTG. COIL CAP.									129800		
TOTALS	9969	20328	11016	23440	9225	11025	2.83	61812	129800	117864	42138

NOTE
DESIGN CONDITIONS
AUG 21, 2 P.M.
SUMMER
OUTDOOR 91°DB, 77°WB
INDOOR 75°DB, 50% RH

WINTER
OUTDOOR 15°F DB
INDOOR 72°F DB

TOTAL HEATING LOAD = 141205 BTUH
TOTAL SENS. COOLING LOAD = 163530 "
TOTAL LAT. COOLING LOAD = 33465 "
TOTAL COOLING LOAD = 196995 "

REQ FORT BELVOIR, VIRGINIA #4030
LOAD SUMMARY TAKE-OFF DATA

MSA 12/4/74

NOTE
MECH. SCHEDULE DATA ON EXIST.
DRWGS. NO. 190 & 191

3Co ADMINIST. BLDG & STORAGE		QUANTITY	WINTER LOAD U	ΔT	HTG FACTOR	TRANS LOAD	INFIL LOAD	UH CAP.	SUMMER LOAD WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR	SOLAR PERCENT
WALL	NW	2351	.2	57	11.4	26801			8	1.6	3762	1	.2	470				
"	NE	895	.2	57	11.4	10203			8	1.6	1432	8	1.6	1432				
"	SW	895	.2	57	11.4	10203			8	1.6	1432	2	.4	358				
"	SE	1944	.2	0														
ROOF		8640	.16	57	9.12	78796			8	1.3	11232	46	7.4	63936				
EDGE LOSS (40BTU/HR FT)		264				10560												
INFILT. (.75AC/HR)		1610					99111											
SENS HTG FACTOR = 61.56																		
UH CAP								160000										
TOTALS						36,563	99,111	360,000			17858			66196				

ELECT(LIGHT) KW 9.10
ELECT.(POWER) KW 4.80

TOTAL HTG. LOAD = 235,074 BTU/HR

NOTE: DESIGN CONDITIONS
OUTDOOR 15°FDB
INDOOR 72°FDB

Prepared by: LEA 12/10/74

- REVISED 5-19-76 LCW

NOTE:
MECH. SCHEDULE DATA ON EXIST. DRWGS. NO. 190 & 191

BEQ FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

#10 BLDG
& 60 ADMINIST
BLDG. #2 OFFICES

WINTER LOAD

	Quantity	U	ΔT	HTG Factor	Trans Load	Infilt. Load	Vent. O.A. Load
Wall NW	426	.2	57	11.4	4856		
" (Partition) NE	1752	.34	0				
" SW	1134	.2	57	11.4	12928		
" SE	426	.2	57	11.4	4856		
Glass SW	346	1.13	57	64.11	22282		
R-E Panel SW	126	.19	57	10.83	1361		
Roof	5402	.16	57	9.12	49266		
Edge Loss (w/wkft)	218			40	8720		
Infilt. (.75 AC/HR)	643					33427	
Vent O.A.	600						
Elect (Light) W	18180						36936
Elect (Power) KW	2.23						
People (205/245)	45						
Sens Factor 18.36							
Lat. Factor 37.4							
CLG. Coil Cap							
HTG. Coil Cap.							
Totals					109269	33427	36936

SUMMER LOAD

	Wall, Roof & Glass Trans ΔT	Factor	Transm Load BTU/HR	Solar Wall & Roof Solar	Factor	Solar Wall & Roof Load BTU/HR	Solar Glass Solar	Factor	Solar Glass Load BTU/HR
Wall NW	9	1.6	682	1	.2	85			
" (Partition) NE		5.4	9461	.	—	—			
" SW	6	1.6	1814	2	.4	454			
" SE	8	1.6	682	10	2.0	852			
Glass SW	16	18.1	6263			—	187		64702
R-E Panel SW	8	1.5	189	21	4.0	504			
Roof	8	1.3	7023	46	7.4	39975			
Totals			26114			41870			64702

	Summer Vent Sens	Summer Vent Lat.	Summer Vent Sens	Summer Vent Lat	People Sens	People Lat	Elect. KW	Elect. BTUH	HTG Coil Cap	CLG Coil Cap Sens	CLG Coil Cap Lat
Infilt. (.75 AC/HR)	9969	20308									
Vent O.A.			11016	22440							
Elect (Light) W							18,206	61812			
People (205/245)					9225	11025					
CLG. Coil Cap										137862	42138
HTG. Coil Cap.									129000	137862	42138
Totals	9969	20308	11016	22440	9225	11025	18,206	61812	129000	137862	42138

NOTE
DESIGN CONDITIONS
AUG 21, 2 P.M.
SUMMER
OUTDOOR 91°DB, 77°WB
INDOOR 75°DB, 50% RH
WINTER
OUTDOOR 14°F DB
INDOOR 72°F DB

TOTAL HTG. LOAD = 141205 BTUH
TOTAL SENS LOAD = 214739 "
TOTAL LAT. LOAD = 33465 "
TOTAL CLG. LOAD = 248204 "

BEQ. FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

NOTE:
MECH. SCHEDULE DATA ON EXIST. DRWGS. NO. 190 & 191

3 CO. ADMINIST BLDG #2 STORAGE		QUANTITY	WINTER LOAD U	WINTER LOAD ΔT	WINTER LOAD HTG FACTOR	WINTER LOAD TRANS LOAD	WINTER LOAD INFIL LOAD	UH CAP	SUMMER LOAD WALL, ROOF & GLASS TRANS ΔT	SUMMER LOAD WALL, ROOF & GLASS TRANS FACTOR	SUMMER LOAD TRANSM LOAD BTU/HR	SUMMER LOAD SOLAR WALL & ROOF SOLAR	SUMMER LOAD SOLAR WALL & ROOF FACTOR	SUMMER LOAD SOLAR WALL & ROOF LOAD BTU/HR	SUMMER LOAD SOLAR GLASS SOLAR	SUMMER LOAD SOLAR GLASS FACTOR	SUMMER LOAD SOLAR GLASS LOAD BTU/HR
WALL	NW	895	.2	57	114	10203			8	1.6	1432	1	.2	179			
"	NE	2351	.2	57	114	26801			8	1.6	3762	8	1.6	3762			
"	SW	1900	.2	0													
"	SE	895	.2	57	114	10203			8	1.6	1432	10	2.0	1790			
ROOF		8640	.16	57	9.12	78796			8	1.3	11232	46	7.4	63936			
EDGE LOSS (40 BTU/LF)		264				10960											
INFILT. (.75 AC/HR)		1610					99111										
GENS. HTG FACTOR																	
UH CAP.								360000									
TOTALS						136963	99,111	360,000			17858			69667			

ELECT (LIGHT) KW 9.10
ELECT (POWER) KW 4.80

TOTAL HTG. LOAD = 235,674 BTU/HR

NOTE
DESIGN CONDITIONS
OUTDOOR 15°FDB
INDOOR 72°FDB

NOTE:
MECH. SCHEDULE DATA ON EXIST.
DRWGS NO. 206 & 207

/REVISED 5-19-76 LCW
REVISED 5/27/76

BEQ. FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAK-OFF DATA

WINTER LOAD

4 Co. ADMINIST. BLDG. OFFICES #1 BLDG		QUANTITY	U	ΔT	HTG FACTOR	TRANS. LOAD	INFILT. LOAD	VENT. O.A. LOAD
WALL	NW	1614	.2	57	11.4	18400		
"	NE	432	.2	57	11.4	4925		
"	SW	432	.2	57	11.4	4925		
" PARTITION	SE	2304	.34	16	—	—		
GLASS	NW	462	1.13	57	64.41	29574		
P-E PANEL	NW	252	.19	57	10.83	2730		
ROOF		6912	.16	57	9.12	63037		
EDGE LOSS (40 BTU/FT)		268			40	10720		
INFILT. (.75 AC/HR)		719					44261	
VENT. OA		800						49248
ELECT. (LIGHT) W		24240						
ELECT. (POWER) KW		2.98						
PEOPLE (205/245)		60						
SENS. FACTOR 18.36								
LAT. FACTOR 37.4								
CLG COIL CAP.								
HTG. COIL CAP.								
TOTALS						134311	44261	49248

SUMMER LOAD

		WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	NW	8	1.6	2582	1	.20	323			
"	NE	8	1.6	691	8	1.6	691			
"	SW	8	1.6	691	2	.4	173			
" PARTITION	SE	16	5.4	12442	—	—	—			
GLASS	NW	16	18.1	8364				40		18480
P-E PANEL	NW	8	1.5	378	1	.19	48			
ROOF		8	1.3	8986	46	7.4	51149			
TOTALS				34132			52384			18480

	SUMMER INFIL. SENS.	SUMMER INFIL. LAT.	SUMMER VENT. SENS.	SUMMER VENT. LAT.	PEOPLE SENS.	PEOPLE LAT.	ELECT. KW	ELECT. BTUH	HTG COIL CAP.	CLG COIL CAP SENS.	CLG COIL CAP LAT.
INFILT. (.75 AC/HR)	13200	26890									
VENT. OA			14688	29920							
ELECT. (LIGHT) W							24.24	82416			
PEOPLE (205/245)					12300	14700					
CLG COIL CAP.										183816	56184
HTG. COIL CAP.									172000		
TOTALS	13200	26890	14688	29920	12300	14700	24.24	82416	172000	183816	56184

NOTE
DESIGN CONDITIONS
AUG 21, 2 P.M.
SUMMER
OUTDOOR 91°FDB, 77°FWB
INDOOR 75°FDB, 50% RH

WINTER
OUTDOOR 15°FDB
INDOOR 72°FDB

TOTAL HTG. LOAD = 183 559 BTU/HR
TOTAL SENS. LOAD = 214,400 "
TOTAL LAT LOAD = 44,620 "
TOTAL CLG. LOAD = 259,020 "

NOTE
MECH. SCHEDULE DATA ON EXIST.
DRWGS. NO. 206 & 207

BEG. FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

400 ADMINIST BLDG STORAGE	QUANTITY	WINTER LOAD U	ΔT	BTU/SQFT	TRANS LOAD	INFILT LOAD	UH CAP	SUMMER LOAD WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL (NET) NW	9200	.37	0													
" NE	840	.2	57	11.4	9576			8	1.6	1344	8	1.60	1344			
" SW	840	.2	57	11.4	9576			8	1.6	1344	2	.40	336			
" SE	3104	.2	57	11.4	35385			8	1.6	4966	10	2.0	6208			
ROOF	11640	.16	57	9.12	106157			8	1.3	15132	46	7.40	86136			
EDGE LOSS (60 BTU/LFT)	312				18480											
INFILT. (.75 AC/HR)	2172					133708										
SENS. HT FACTOR = 61.56																
UH CAP.							480000									
TOTALS					173174	133708	480,000			22786			94024			

ELECT. (LIGHT) KW 18.10
ELECT. (POWER) KW 5.35

TOTAL HTG. LOAD = 306882 BTUH

NOTE
DESIGN CONDITIONS
OUTDOOR 15°F DB
INDOOR 72°F DB

f.M 6/76

REVISED 5-17-76 LCW

NOTE:
MECH. SCHEDULE ON EXIST.
DWGS. NO. 30-09-15 PLATE 262

MIUS FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

BUILDING - 12
TWO BATTALION HEADQUARTERS & CLASSROOM

Item		Quantity	Winter U	Winter ΔT	Htg Factor	Winter Trans Load	Winter Infiltr Load	Winter Vent. O.A. Load	Summer Wall, Roof & Glass Trans ΔT	Summer Trans Factor	Transm Load BTU/HR	Solar Wall & Roof Solar	Solar Wall & Roof Factor	Solar Wall & Roof Load BTU/HR	Solar Glass Solar	Solar Glass Factor	Solar Glass Load BTU/HR
WALL	NW	1255	.29	57	13.68	17168			8	1.9	2384	1	.24	301			
— " —	NE	1804	.29	57	13.68	24679			8	1.9	3428	8	1.92	3464			
— " —	SE	1255	.29	57	13.68	17168			8	1.9	2384	10	2.4	3012			
— " —	SW	2024	.29	57	13.68	27688			8	1.9	3846	2	.48	971			
GLASS	NW	201	1.13	57	64.41	12946			16	18.1	3688				40		8040
— " —	NE	510	1.13	57	64.41	32849			16	18.1	9231				32		16320
— " —	SE	201	1.13	57	64.41	12946			16	18.1	3638				34		6834
— " —	SW	290	1.13	57	64.41	18679			16	18.1	5249				187* / 40*		19638 / 7800
LAT LOAD FACTOR (55x.68)		37.4															
ROOF		11989	.15	57	8.55	102506			8	1.2	14387	46	6.9	82724			
EDGE LOSS (40BTU/HFT)		566															
INFLTR (1.5 AC/HR) LOSS 6		1561															
LOSS 37		1561					96095										
VENTILATION O.A.		2-14,560/2810	1.08 MIN	37	61.56			160670* (887,000)									
ELECTR. (LIGHTS) KW		30.04															
ELECTR. (POWER) KW		17.10kw-(10HP-7500) [illegible]															
PEOPLE 245S./155L.		12															
225S./105L.		84															
CLG. COIL CAP																	
HTG. COIL CAP																	
TOTALS						266.6M	96095	160670*			48185			90472			58632

Item	Summer Infiltr Sens	Summer Infiltr Lat	Summer Vent. OA Sens	Summer Vent. OA Lat	People Sens	People Lat	Elect KW	Elect BTUH	Exist. Htg Coil Capacity	Exist. Clg Coil Capacity Sens	Exist. Clg Coil Capacity Lat
INFLTR LOSS 37	28645	58381									
VENTILATION O.A.			45100	97615							
ELECTR. (LIGHTS) KW							30.04	102.4M			
PEOPLE 245S./155L.					2940	1860					
225S./105L.					18900	8820					
CLG. COIL CAP										402.3M	413.2
HTG. COIL CAP									1120000		
TOTALS	28645	58381	45100	97615	21840	10680	30.04	102.4	1120000		
	87026T.		142715							835,900 TOTAL	

		BTUH
TOTAL HEATING LOAD		427,270
TOTAL SENSIBLE COOLING LOAD		366,629
TOTAL LATENT COOLING LOAD		108,295
TOTAL COOLING LOAD		474,924

NOTE:
DESIGN CALCULATIONS ARE BASED UPON AUG. 31, AT 2:00 PM OUTDOOR CONDITIONS 91°F DB, 77°F WB INDOOR CONDITIONS 75°F DB, 50% RH
WINTER CONDITIONS OUTDOOR DESIGN TEMPERATURE = +15°F DB
INDOOR CONDITION 72°F DB

* 105# x 187
* 195# x 40 SHADE FROM OVERHANG

NOTE: BASEMENT FIRST + SECOND FLOORS
MECH. SCHEDULE DATA ON [illegible]
DWG. NO. 39-22-2-2 HEADQUARTERS BLDG REGIMENTAL/BI

WB 4/76
Revised DEF 4/21/76
Revised DMI 5/4/76

MIUS FORT BELVOIR, VIRGINIA #4430
LOAD SUMMARY TAKE-OFF DATA

WINTER LOAD

HEADQUARTERS BLDG REGIMENTAL/BRIGADE BUILDING - 13		QUANTITY	U	ΔT	HTG FACTOR	TRANSM LOAD	INFILTR LOAD	VENT LOAD
WALL	NW	2060	.20	57	11.4	23,485		
WALL	NE	720	.20	57	11.4	8210		
WALL	SW	720	.20	57	11.4	8210		
WALL	SE	1600	.20	57	11.4	18240		
GLASS	NW	236.0	1.13	57	64.41	15 200		
GLASS	NE	96.0	1.13	57	64.41	6185		
GLASS	SW	96.0	1.13	57	64.41	6185		
GLASS	SE	402.0	1.13	57	64.41	25,900		
SANDWICH PANELS	NW	104.0	.19	57	10.83	1127		
"	NE	52.0	.19	57	10.83	564		
"	SW	52.0	.19	57	10.83	564		
"	SE	78.0	.19	57	10.83	845		
LAT. LOAD FACTOR		37.4						
ROOF		3200	.16	57	9.64	31,000		
EDGE LOSS (50 BTU/FT)		240				12,000		
INFILT.		1020 CFM	1.08	57	61.5		62,730	
VENTILATION O.A.		776 CFM	1.08	57	61.5			47710
ELECT (LIGHTS) KW		13.0 KW						
ELECT (POWER) KW		13.0 KW						
PEOPLE		45						
CLG. COIL CAP.								
HTG. COIL CAP.								
TOTALS						157,714	62,730	47,710

SUMMER LOAD

Item	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL NW	8	1.6	3296	1	.20	412			
WALL NE	8	1.6	1152	8	1.60	1152			
WALL SW	8	1.6	1152	2	.40	288			
WALL SE	8	1.6	2560	10	2.00	3200			
GLASS NW	16	18.08	4267				40		9440
GLASS NE	16	18.08	1736				32		3072
GLASS SW	16	18.08	1736				187		17952
GLASS SE	16	18.08	7268				34		13668
SANDWICH PANELS NW	8	1.52	158	12	2.28	237			
" NE	8	1.52	79	12	2.28	119			
" SW	8	1.52	79	21	3.99	208			
" SE	8	1.52	119	21	3.99	311			
ROOF	8	1.28	4096	46	7.36	23552			
TOTALS			21,899			29479			44132

LOAD SUMMARY

Item	SUMMER INFILTR. SENS	SUMMER INFILTR. LAT	SUMMER VENT. OA SENS	SUMMER VENT. OA LAT	PEOPLE SENS	PEOPLE LAT	ELECT KW	ELECT BTUH	HTG COIL CAPACITY	CLG COIL CAPACITY SENS	CLG COIL CAPACITY LAT
INFILT.	17625	35,145									
VENTILATION O.A.			13395	28985							
ELECT (LIGHTS)							13.00	44395			
ELECT (POWER)							2.50	8280			
PEOPLE					11025	6975					
CLG./HTG. COIL CAP.									HC 218800 / 65031	190.45	26.45
TOTALS	17625	35,145	13395	28985	11025	6975	15.50	52675	526408		

NOTE:
DESIGN CALCULATIONS ARE
BASED UPON AUG. 21, AT
2:00 PM OUTDOOR CONDITIONS
91°F DB, 77°F WB. INDOOR
CONDITIONS 75°F WB & 50% RH
WINTER CONDITIONS OUTDOOR
DESIGN TEMPERATURE +15°F DB
INDOOR CONDITION 72°F DB

TOTAL HEATING LOAD	=	220,450 BTUH
TOTAL SENSIBLE COOLING LOAD	=	178,405 BTUH
TOTAL LATENT COOLING LOAD	=	35,960 BTUH
TOTAL COOLING LOAD	=	214,365 BTUH

HW PUMP ½ HP
HCW " 3 HP
CP " ½ HP
CP " ½ HP
EF-1 FAN ⅛ HP
SF-1 " ⅛ HP
HW HTR 4 KW
PC UNITS 4.5 KW
3 EWC @ ⅓ HP 1 HP
13.0 KW

MIUS FORT BELVOIR, VIRGINIA [illegible]
LOAD [illegible] TAKE-OFF DATA

AH 4/22/76
Rev. at [illegible] 7/19/76

NOTE:
MECH. SCHEDULE DATA ON
DWG NO. 36-25-08 PLATE 151 (M-2)

WINTER LOAD

FOOD SERVICE FACILITY / BUILDING - 14	QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFILTR LOAD	VENT. O.A. LOAD
WALL NW (W1)	59/858 ft	.22	57	12.54	10759		
" NE	0/1500 ft	.22	57	12.54	[illegible]		
" SE	54/858 ft	.22	57	12.54	[illegible]		
" SW	1092/1042 ft	.22	57	12.54	[illegible]		
W-2 WALL NW	425/585 ft	.18	57	[illegible]	[illegible]		
" NE	0	.18	57	[illegible]			
" SE	425/[illegible]	[illegible]	57	10.26	[illegible]		
" SW	217/277 ft	[illegible]	[illegible]	10.26	[illegible]		
GLASS NW	230/230 ft	1.13	57	64.41	[illegible]		
" NE	0/298 ft	1.13	57	64.41	19184		
" SE	230/230 ft	1.13	57	64.41	[illegible]		
" SW	333/333 ft	1.13	57	[illegible]	21449		
" SW (SHADE)	333/333 ft	1.13	57	64.41	21448		
LAT. LOAD FACTOR (55 x .62)	9675/37.4						
ROOF	15172 ft	.12	57	6.84	[illegible]		
EDGE LOSS, 50 BTUH/FT	[illegible]				[illegible]		
INFILT (.75 AC/HR) 1.08 x 17	[illegible]						
1.08 x 57	[illegible]					116717	
VENT. O.A.	(48725 CFM HTG ONLY + 17000 CFM [illegible] ONLY)						2999 [illegible]
ELECT. (LIGHT) KW	517 [illegible] / 41.3	[illegible]			5100 [illegible]	36,835 *	2266950
ELECT. (POWER) KW	331 [illegible] / 2-7[illegible]						
PEOPLE 275 L/275 L	340						
CLG. COIL CAP.							
HTG. COIL CAP.							
TOTALS					219449	116717	2266950

SUMMER LOAD

Item	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL NW	8	1.76	950	1	.22	119			
WALL NE	8	1.76	0	8	1.76	0			
WALL SE	8	1.76	950	10	2.2	1188			
WALL SW	8	1.76	1834	2	.44	459			
W-2 WALL NW	8	1.44	612	1	.18	77			
W-2 WALL NE	8	1.44	0	8	1.44	0			
W-2 WALL SE	8	1.44	612	10	1.8	765			
W-2 WALL SW	8	1.44	312	2	.36	78			
GLASS NW	16	18.08	4158				40		7200
GLASS NE	16	18.08	0				32		0
GLASS SE	16	18.08	4158				34		7820
GLASS SW	16	18.08	6021				187		62271
GLASS SW (SHADE)	16	18.08	6020				40		13320
ROOF	8	.96	9288	46	5.52	53406			
TOTALS			34915			56092			92611

Item	SUMMER INFILT. SENS.	SUMMER INFILT. LAT.	SUMMER VENT. OA SENS.	SUMMER VENT. OA LAT.	PEOPLE SENS.	PEOPLE LAT.	EQUIP. KW	EQUIP. BTUH	HTG. COIL CAPACITY	CLG. COIL CAPACITY SENS. LAT.
INFILT.	34810	70910								
VENT. O.A. (MAX. MZ)			293.8	635.8						
MIN. OA Load			* 88.5	190.75						
ELECT. (LIGHT)							41.3	141040		
ELECT. (POWER)							45.34	156545 **		
PEOPLE					93500	93500				
CLG./HTG. COIL CAP.									2952[illegible] 34900	2,357,000
TOTALS	34810	70910	2938	6358	93500	93500	87.14	297585	3005300	2352000

NOTE:
DESIGN CALCULATIONS ARE BASED UPON AUG. 21, AT 3:00 PM OUTDOOR CONDITIONS 91°F DB, 77°F WB.
INDOOR CONDITIONS 75°F DB, 50% RH
WINTER CONDITIONS
OUTDOOR DESIGN TEMP = 15°F DB, INDOOR CONDITION 72°F DB

TOTAL HEATING LOAD = 2,556,069 BTUH
TOTAL SENSIBLE COOLING LOAD = 868,503 BTUH
TOTAL LATENT COOLING LOAD = 729,300 BTUH
TOTAL COOLING LOAD 1,597,803 BTUH

Note: Kitchen Equipment load half 2X 149735
= 299470
= 87.68 KW
50% Diver
= 43.84
2.0 KW
** = 45.84 KW

Prepared by RM 4/26/76
Approved by DEF 5/4/76
Revised RM 5/20/76

NOTE:
MECH SCHEDULE DATA ON
DWGS. NO. 38-01-13 PLATE 369

MIUS FORT BELVOIR, VIRGINIA #4930
LOAD SUMMARY TAKE-OFF DATA

UNIT CHAPEL
BUILDING – 15

WINTER LOAD

UNIT CHAPEL BUILDING – 15	QUANTITY	U	ΔT	HTG FACTOR	TRANS LOAD	INFILTR LOAD	VENT O.A. LOAD
WALL NE	1744	.22	57	12.54	21870		
" SE	1223	.22	57	12.54	15336		
" SW	1859	.22	57	12.54	23299		
" NW	1470	.22	57	12.54	18434		
GLASS NE (.85F)	442	1.13	57	64.41	28469		
" SE (.85F)	128	1.13	57	64.41	8245		
" SW (.85F)	332	1.13	57	64.41	21384		
" NW (.85F)	381	1.13	57	64.41	24540		
(.8 SHADING FACT)							
LAT LOAD FACTOR (55 x .68)	37.4						
ROOF	8684	.10	57	5.7	49500		
EDGE LOSS (40BTUH/FT)	470						
INFILT (.75AC/HR) 1.08 x 17	1633						
1.08 x 57	1633					100528	
VENTILATION O.A.	3000	1.08	57				184680
ELECTR (LIGHTS) KW	10.39						
ELECTR (POWER) KW (T 21P)	1.55						
PEOPLE 225C./WGL.	308						
CLG. COIL CAP.							
HTG. COIL CAP.							
TOTALS					211,030	100528	184680

SUMMER LOAD

UNIT CHAPEL BUILDING – 15	WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL NE	8	1.76	3069	8	1.76	3069			
" SE	8	1.76	2153	10	2.2	2691			
" SW	8	1.76	3263	2	.44	816			
" NW	8	1.76	2587	1	.22	323			
GLASS NE (.85F)	16	18.08	7991				32	25.6	11315
" SE (.85F)	16	18.08	2314				34	27.2	3482
" SW (.85F)	16	18.08	6003				187	149.6	49667
" NW (.85F)	16	18.08	6889				40	32.0	12192
ROOF	8	.8	6947	46	4.6	39946			
TOTALS			41216			46,845			76656

LOAD SUMMARY

UNIT CHAPEL BUILDING – 15	TOTAL GAIN LOAD	SUMMER INFILTR SENS.	SUMMER INFILTR LAT.	SUMMER VENT OA. SENS	SUMMER VENT OA. LAT.	PEOPLE SENS.	PEOPLE LAT.	ELECTR. KW	ELECTR. BTUH	EXIST. HTG. COIL CAPACITY	EXIST. CLG. COIL CAPACITY SENS	EXIST. CLG. COIL CAPACITY LAT
INFILT (.75AC/HR) 1.08 x 17		29971	61074									
VENTILATION O.A.				55080	12200							
ELECTR (LIGHTS) KW								10.39	35430			
ELECTR (POWER) KW (T 21P)								1.55	5240			
PEOPLE 225C./WGL.						69300	32340					
CLG. COIL CAP.											335M	197M
HTG. COIL CAP.										444110		
TOTALS		29971	61074	55080	12200	69300	32340	11.94	40670	444110	335M	197M

NOTE:
DESIGN CALCULATIONS ARE BASED UPON AUG. 21, AT 2:00PM
OUTDOOR CONDITIONS 91°F DB; 77°F WB. INDOOR CONDITIONS 75°F DB & 50% RH.
WINTER CONDITIONS OUTDOOR
DESIGN TEMPERATURE = +15°F DB
INDOOR CONDITION 72°F DB

TOTAL HEATING LOAD	=	395,710 BTUH
TOTAL SENSIBLE COOLING LOAD	=	329,767
TOTAL LATENT COOLING LOAD	=	144,540
TOTAL COOLING LOAD		474,307 BTUH

Revised DRF 5/6/76
Revised AM 5/11/76
REV AM 5/21/76

NOTE:
MECH. SCHEDULE DATA ON
DWGS. NO. 31-06-21 PLATE 333

GYMNASIUM-16		QUANTITY	WINTER LOAD U	ΔT	HTG FACTOR	TRANSM LOAD	INFILTR LOAD	VENT O.A. LOAD	SUMMER LOAD: WALL, ROOF & GLASS TRANS ΔT	FACTOR	TRANSM LOAD BTU/HR	SOLAR WALL & ROOF SOLAR	FACTOR	SOLAR WALL & ROOF LOAD BTU/HR	SOLAR GLASS SOLAR	FACTOR	SOLAR GLASS LOAD BTU/HR
WALL	W-1	3240	.24	57	13.68	44323			8	1.92	6220	1	.24	777			
—"—	W-3	820	.20	57	11.40	9348			8	1.6	1312	1	.20	164			
—"— NW	W-5	338	.16	57	9.12	3083			8	1.28	432	1	.16	54			
—"—	W-9	52	.21	57	11.97	622			8	1.68	87	1	.21	10			
—"—	W-1	2120	.24	57	13.68	29002			8	1.92	4070	8	1.92	4070			
—"— NE	W-2	367	.22	57	12.54	4602			8	1.76	645	8	1.76	645			
—"—	W-9	1140	.21	57	11.97	13646			8	1.68	1915	8	1.68	1915			
—"— SE	W-1	4479	.24	57	13.68	61273			8	1.92	8599	10	2.4	10749			
—"—	W-2	173	.22	57	12.54	2169			8	1.76	304	10	2.2	380			
—"— SW	W-1	2859	.24	57	13.68	39111			8	1.92	5489	2	.48	1372			
—"—	W-2	695	.22	57	12.54	8715			8	1.76	1223	2	.44	305			
GLASS NW		110	1.13	57	64.41	7085			16	18.08	1988				90		9900
—"— NE		37	1.13	57	64.41	2383			16	18.08	668				32		1184
—"— SE		161	1.13	57	64.41	10370			16	18.08	2910				34		5479
—"— SW		110	1.13	57	64.41	7085			16	18.08	1988				187		20570
LAT. LOAD FACTOR (55%-6)		37.4															
ROOF	R-1	12952	.18	57	10.26	132888			8	1.44	18650	46	8.28	107242			
	R-2	7616	.15	57	8.55	65117			8	1.2	9139	46	6.90	52550			
	R-3	789	.13	57	7.41	5847			8	1.04	820	46	5.98	4718			
EDGE LOSS (ROBTUH/FT)		625				25000											
INFILTR (75 AC/HR) 1.08x16		5890															
1.08x57		5890					362577										
VENT. O.A.		26100 CFM DAY (NO COOLING)						1606716									
ELECT. (LIGHTS) KW		71.85															
ELECT. (POWER) KW		92.25															
PEOPLE																	
CLG. COIL CAP.																	
HTG. COIL CAP.																	
TOTALS						471669	362577	1606716			66459			181951			31628

MILT FORT BELVOIR [illegible]
LOAD SUMMARY [illegible]
NO COOLING

	TOTAL GLASS LOAD	SUMMER INFILTR SENS	SUMMER INFILTR LAT.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
INFILTR (75 AC/HR) 1.08x16		101.2M	2202M								
VENT. O.A.				451M	976M						
ELECT. (LIGHTS) KW								71.85	245M		
PEOPLE						56070	66830				
CLG. COIL CAP.										2529M	18,000
TOTALS		1012M	2202M	451M	976M	56070	66830	71.85	245M	2529M	18000

NOTES:
DESIGN CALCULATIONS ARE BASED UPON AUG. 21, AT 2PM. OUTDOOR CONDITIONS 91°F DB, 77°F WB; INDOOR CONDITIONS 75°F DB, 56% RH.
WINTER CONDITIONS AT OUTDOOR DESIGN TEMP = +15°F DB, INDOOR CONDITION 72°F DB

TOTAL HEATING LOAD = 2,078,385 BTUH
TOTAL SENS. COOLING LOAD = 1,035,110
TOTAL LAT. COOLING LOAD = 1,042,830
TOTAL COOLING LOAD = 2,077,940 BTUH

1-1

AD-A038 722 GAMZE-KOROBKIN-CALOGER INC CHICAGO ILL F/G 13/13
PRELIMINARY DESIGN OF A TOTAL UTILITY PILOT DEMONSTRATION PROJE--ETC(U)
SEP 76 L KOROBKIN DACA73-75-C-0002
UNCLASSIFIED USAFESA-RT-2030 NL

3 OF 4
AD
A038722

Prepared by DF 6/7/76
Approved by
REV AM 5/21/76
REV B.O. 6/1/76

MILS FORT BELVOIR VA. #4490
BUILDING LOAD SUMMARY DATA

BUILDING DESIGNATION NUMBER	DESCRIPTION + TYPE OF BUILDING	FLOOR AREA SQ. FT.	TOTAL BUILDING VOLUME	HEATING LOAD DATA: TRANS. LOAD	HEATING LOAD DATA: INFILT. LOAD	HEATING LOAD DATA: OUTSIDE AIR LOAD	COOLING LOAD DATA: TRANS. + SOLAR	COOLING LOAD DATA: INFILT. LOAD	COOLING LOAD DATA: OUTSIDE AIR LOAD	PEOPLE LOAD: SENSIBLE	PEOPLE LOAD: LATENT	LIGHTS: KW PER ft²	ELECTRICAL LOADS: LIGHTING KW	ELECTRICAL LOADS: POWER KW	EXIST. HEATING COIL CAP. LOADS	EXIST. COOLING COIL CAP. LOADS	EXIST. DOMESTIC HOT WATER LOADS
1	EM BARRACKS BUILDING (3) MODULES (BCD) (BCD) (ACD)	32220	257760	718720	198350	269610	587275	179625	244515	34300	28700		18.0	15.5	1248250	1072885	450000
2	EM BARRACKS BUILDING (3) MODULES (BCD) (BCD) (ACD)	32220	257760	718720	198350	269610	587275	179625	244515	34300	28700		18.0	15.5	1248250	1072885	450000
3	EM BARRACKS BUILDING (3) MODULES (BCD) (ACD) (BCD)	32220	257760	720468	198350	269610	588480	179625	244220	34300	28700		18.0	15.5	1248250	1072895	450000
4	EM BARRACKS BUILDING (3) MODULES (BCD) (ACD) (BCD)	32220	257760	720350	198350	269610	593740	179625	244220	34300	28700		18.0	15.5	1248250	1072895	450000
5	EM BARRACKS BUILDING (4) MODULES (ACD) (BCD) (BCD) (ACD)	42960	343680	962665	264464	361950	791355	239500	328460	45080	37720		23.8	22.0	1662500	1423090	700000
6	EM BARRACKS BUILDING (2) MODULES (BCD) (ACD)	21480	171840	478469	132232	180975	369450	119750	163930	22540	18860		12.0	11.0	831250	711545	450000
7	DISPENSARY GROUP BUILDING	3195		88377	21425	31400	79845	19405	28440	2450	2050		6.70	31.0	250000	128740	30690 9.0 kw
8	BRANCH EXCHANGE BUILDING	4720		122400	21425	163800	87750	19405	133365	12250	10250		14.875	23.5	423000	429000	30690 9.0 kw
9	3 COMPANY ADMIN. #1 (OFF.) (STOR.)	5402 8640		104270 136565	33427 99110	36936 0	81480 0	30277 0	33455 0	11025 0	9225 0		15.45 9.10	2.23 4.80	129000 360000	180000 NONE	40920 12.0 kw
10	3 COMPANY ADMIN. #2 (OFF.) (STOR.)	5402 8640		104270 136565	33427 91110	36936 0	132690 0	30477 0	33455 0	11025 0	9225 0		15.45 9.10	2.23 4.80	129000 360000	180000 NONE	40920 12.0 kw
11	4 COMPANY ADMIN. (OFF.) (STOR.)	6910 11640	87439	134310 173175	14260 133710	49248 0	105000 0	40090 0	44610 0	14700 0	12300 0		20.60 12.10	2.98 5.35	172000 480000	240000 NONE	59560 16.0 kw
12	SECOND BATTALION HQ AND CLASSROOM BLDG.	11989	170864	264600	96095	160620	197290	87026	142715	21840	10680		25.50	17.1	1120000	835900	26,000 B 7.5 kw
13	HEADQUARTERS BUILDING REGIMENTAL/BRIGADE	9843	98430	157720	62730	47710	101310	55770	42380	11025	6975		15.30	10.70	526408	216898	136608 4.0 kw
14	FOOD SERVICE FACILITY BUILDING	15172	151720	289120	116717	2266950	183620	105720	929600	93500	93500		34.35 9.00	34.5 60.6	5005300	2352000	1040000
15	UNIT CHAPEL BUILDING	8684	165606	211030	100530	184680	164720	91045	167280	69300	32340		7.70	10.5	444110	532510	13660 4.0 kw
16	GYMNASIUM BUILDING (NO COOLING SYSTEM)	20781	484384	471670	362577	1606716	0	0	0	0	0		51.80	39.81	2529000	(4k 12000)	690000
		284701		6715464	2082710	6206411	4,651,480	1556765	3025160	451935	357925		264.1250	345.10	17414568	11521243	4680000

Less Kw Road (Htr only)

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By DEF Date 5/6/76
Chkd. By Date
Sheet 1 of
Job No. 4430

Project MIUS FORT BELVOIR, VA Structure
For DOMESTIC WATER DEMANDS *

* BASED ON 1970 ASHRAE GUIDE AND DATA BOOK TABLE 11 HOT WATER DEMANDS - AVERAGE DAY

BUILDINGS NO. 1 THRU 4 (TYPICAL)
EM BARRACKS
AVERAGE DAY CONSUMPTION = 140 PEOPLE X 13.1 GAL/P
= 1834.0 GALLONS

BUILDING NO. 5
EM BARRACKS
AVERAGE DAY CONSUMPTION = 192 PEOPLE X 13.1 gal/PERSON
= 2516.0 GALLONS PER DAY

BUILDING NO. 6
EM BARRACKS
AVERAGE DAY CONSUMPTION = 92 PEOPLE X 13.1 GAL/PERSON
= 1206.0 GALLONS PER DAY

BUILDING NO. 7
GROUP DISPENSARY
AVERAGE DAY CONSUMPTION = 10 PEOPLE X 12.0 gal/PERSON
= 120.0 GALLONS PER DAY

BUILDING NO. 8
BRANCH EXCHANGE
AVERAGE DAY CONSUMPTION = 50 PEOPLE PER MEAL X 3
= 150 X 2.4 GAL PER MEAL
= 360.0 GALS. PER DAY

BUILDING NO. 9 AND 10 (TYPICAL)
3 CO. ADMIN. OFFICE AND STORAGE
AVERAGE DAY CONSUMPTION = 45 PEOPLE X 1.0 GAL/P/DAY
= 45 GALS. PER DAY.

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By DEF Date 5/6/76 Sheet 2 of
Chkd. By Date Job No. 4430
Project MIUS FORT BELVOIR, VA. Structure
For DOMESTIC WATER DEMANDS - CONT.

BUILDING NO. 11
4 CO. ADMIN. OFFICE + STORAGE
AVERAGE DAY CONSUMPTION = 60 PEOPLE X 1.0 GAL/P/DAY
= 60 GALS PER DAY.

BUILDING NO. 12
BATTALION HEADQUARTERS + CLASSROOM
AVERAGE DAY CONSUMPTION = 96 PEOPLE X 1.0 GAL/P/DAY
= 96.0 GALS PER DAY

BUILDING NO. 13
HEADQUARTERS REGIMENTAL/BRIGADE
AVERAGE DAY CONSUMPTION = 45 PEOPLE X 1.0 GAL/P/DAY
= 45.0 GALS PER DAY

BUILDING NO. 14
FOOD SERVICE FACILITY
AVERAGE DAY CONSUMPTION = 700 PER MEAL X 3 PER DAY
= 2100 MEALS X 2.4 GAL/MEAL
= 5040.0 GALS PER DAY

BUILDING NO. 15
UNIT CHAPEL
AVERAGE DAY CONSUMPTION = 16 PEOPLE X 1.0 GAL/P./DAY
= 16 GALS. PER DAY

BUILDING NO. 16
GYMNASIUM
AVERAGE DAY CONSUMPTION = 700 P/DAY X 2.0 GAL/PER
= 1400.0 GALS. PER DAY

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By DEF Date 12/3/74 Sheet 1 of
Chkd. By Date Job No. 4430
Project MIUS FORT BELVOIR, VA. Structure
For INCINERATOR CAPACITY DATA

CLASSIFICATION	BUILDING TYPE	QUANITIES OF WASTE PRODUCED
RESIDENTIAL TYPE 0 WASTE 8 TO 10 LBS PER CU. FT.	BUILDINGS NO. 1 THRU 6	4 LBS/SLEEPING ROOM PER DAY
COMMERCIAL BLDG TYPE 2 WASTE	BLDG NO. 8	4 LBS / 100 ⌀ PER DAY
	BLDGS NO. 7, NO. 9 THRU 13, 15 AND 16	1 LBS / 100 ⌀ PER DAY
INSTITUTIONS TYPE 3 WASTE 30 TO 35 LBS. PER CU. FT.	BUILDING NO. 14	2 LBS/ MEAL PER DAY

AVERAGE WEIGHT OF REFUSAGE

TYPE 0 WASTE = 8 TO 10 LBS. PER CU. FT.
10% MOISTURE, 5% INCOMBUSTIBLE SOLIDS,
HEATING VALUE - 8500 BTU PER LB.

TYPE 2 WASTE = 15 TO 20 LBS PER CU. FT.
50% MOISTURE, 7% INCOMBUSTIBLE SOLIDS,
HEATING VALUE = 4300 BTU PER LB.

TYPE 3 WASTE = 30 TO 35 LBS PER CU. FT.
70% MOISTURE, 5% INCOMBUSTIBLE SOLIDS,
HEATING VALUE = 2500 BTU PER LB.

Comp. By DEF Date 12/3/74

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Sheet 2 of

Chkd. By .... Date ....

Job No. 4430

Project MIUS FORT BELVOIR, VA. Structure

For INCINERATOR CAPACITY DATA.

BUILDING NO. 1 (EM BARRACKS)
BLDG NO. 2, 3 AND NO. 4 TYPICAL

LIVING MODULE 1 = 24
SERVICE " 2 = 20
LIVING " 3 = 24

TYPE 0 WASTE = 68 X 4 LBS/SLEEPING RM/DAY
= 272 LBS PER DAY PER BLDG.

BUILDING NO. 5 (EM BARRACKS)

SERVICE MODULE 1 = 20
LIVING " 2 = 24
LIVING " 3 = 24
SERVICE " 4 = 20

TYPE 0 WASTE = 88 X 4 LBS/SLEEPING RM/DAY
= 352 LBS PER DAY PER BLDG.

BUILDING NO. 6 (EM BARRACKS)

SERVICE MODULE 1 = 20
LIVING MODULE 2 = 24

TYPE 0 WASTE = 44 X 4 LBS/SLEEPING RM/DAY
= 176 LBS PER DAY PER BLDG.

BUILDING NO. 7 (GROUP DISPENSARY)
BUILDING FLOOR AREA
3200.0 SQ. FT = 1 LBS PER 100 ft^2 PER DAY
= 32.0 X 1 LBS PER DAY
= 32.0 LBS PER DAY

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By DEF Date 12/3/74 | Sheet 3 of
Chkd. By REVISED Date 6/1/76 | Job No. 4430
Project MIUS FORT BELVOIR, VA Structure
For INCINERATOR CAPACITY DATA

BUILDING NO. 8 (BRANCH EXCHANGE)

BUILDING FLOOR AREA
4720.0 SQ. FT. = 1 LBS PER 100 ft^2 PER DAY
= 47.2 X 1 LBS PER DAY
= 47.2 LBS PER DAY

BUILDING NO. 9 AND 10 (3 CO. ADMIN. + STOR.)

BUILDING FLOOR AREA
14,000 SQ. FT. = 1 LBS PER 100 ft^2 PER DAY
= 140.0 X 1 LBS PER DAY
= 140.0 LBS PER DAY

BUILDING NO. 11 (4 CO. ADMIN. + STOR.)

BUILDING FLOOR AREA
18,500 SQ. FT. = 1 LBS PER 100 ft^2 PER DAY
= 185.0 X 1 LBS PER DAY
= 185.0 LBS PER DAY

BUILDING NO. 12 (TWO BATTALOIN HEADQUARTERS) AND CLASSROOM

BUILDING FLOOR AREA
12,000 SQ. FT. = 1 LBS PER 100 ft^2 PER DAY
= 120.0 X 1 LBS PER DAY
= 120.0 LBS PER DAY

BUILDING NO. 13 (HEADQUARTERS BUILDING) REGIMENTAL / BRIGADE

BUILDING FLOOR AREA
10,000 SQ. FT. = 1 LBS PER 100 ft^2 PER DAY
= 100.0 X 1 LBS PER DAY
= 100.0 LBS PER DAY

Comp. By DEF Date 6/1/76

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Sheet 4 of
Job No. 4430

Chkd. By Date

Project MILLS FORT BELVOIR, VA Structure
For INCINERATOR CAPACITY DATA

BUILDING NO. 14 (FOOD SERVICE FACILITY)

900 MEN PER MEAL X 3 MEALS PER DAY
= 2700 MEALS PER DAY
= 2700 X 2LBS / MEAL / DAY
= 5400 LBS PER DAY

BUILDING NO. 15 (UNIT CHAPEL)

BUILDING FLOOR AREA
8600 SQ. FT. = 1/2 LBS PER 100 FT² PER DAY
= 86.0 X 1/2 LB PER DAY
= 42.0 LBS PER DAY

BUILDING NO. 16 (GYMNASIUM)

BUILDING FLOOR AREA
20,000 SQ. FT. = 1 LBS PER 100 FT² PER DAY
= 200.0 X 1 LBS PER DAY
= 200.0 LBS PER DAY

MIUS-FORT BELVOIR,VA. -PROJECT #4430

TOTAL ESTIMATED MAXIMUM DEMAND LOADS

BUILDING NO. 1 and No. 2 (EACH)

Domestic hot water load	1,834	GAL/DAY
Heating Load	988,330	BTU/HR
Cooling load	941,118	BTU/HR
Electrical load max.	33.5	KW
Incinerator waste load	272	LBS/DAY

BUILDING NO.3

Domestic hot water load	1,834	GAL/DAY
Heating load	990,080	BTU/HR
Cooling load	944,143	BTU/HR
Electrical load max.	33.5	KW
Incinerator waste load	272	LBS/DAY

BUILDING NO. 4

Domestic hot water load	1,834	GAL/DAY
Heating load	989,960	BTU/HR
Cooling load	949,487	BTU/HR
Electrical load max.	33.5	KW
Incinerator waste load	272	LBS/DAY

BUILDING NO. 5

Domestic hot water load	2,516	GAL/DAY
Heating load	1,324,615	BTU/HR
Cooling load	1,274,677	BTU/HR
Electrical load max.	45.8	KW
Incinerator waste load	352	LBS/DAY

BUILDING NO. 6

Domestic hot water load	1,206	GAL/DAY
Heating load	659,445	BTU/HR
Cooling load	610,092	BTU/HR
Electrical load max.	23.0	KW
Incinerator waste load	176	LBS/DAY

BUILDING NO. 7 -GROUP DISPENSARY

Domestic hot water load	120	GAL/DAY
Heating load	119,780	BTU/HR
Cooling load	139,745	BTU/HR
Electrical load max.	37.75	KW
Incinerator waste load	32	LBS/DAY

MIUS-FORT BELVOIR, VA. -PROJECT #4430

TOTAL ESTIMATED MAXIMUM DEMAND LOADS - PAGE 2

BUILDING NO. 8- BRANCH EXCHANGE

Domestic hot water load	360	GAL/DAY
Heating load	286,191	BTU/HR
Cooling load	302,769	BTU/HR
Electrical load max.	38.375	KW
Incinerator waste load	400	LBS/DAY

BUILDING NO.9- 3 CO. ADMIN. & STORAGE

Domestic hot water load	360	GAL/DAY
Heating load	376,881	BTU/HR
Cooling load	196,995	BTU/HR
Electrical load max.	30.25	KW
Incinerator waste load	140	LBS/DAY

BUILDING NO. 10- 3 CO. ADMIN. & STORAGE

Domestic hot water load	360	GAL/DAY
Heating load	376,881	BTU/HR
Cooling load	248,204	BTU/HR
Electrical load max.	30.25	KW
Incinerator waste load	140	LBS/DAY

BUILDING NO. 11- 4 CO. ADMIN & STORAGE

Domestic hot water load	460	GAL/DAY
Heating load	490,445	BTU/HR
Cooling load	259,020	BTU/HR
Electrical load max.	39.50	KW
Incinerator waste load	185	LBS/DAY

BUILDING NO. 12- TWO BATTALION HDQTRS. AND CLASSROOM

Domestic hot water load	96.0	GAL/DAY
Heating load	427,270	BTU/HR
Cooling load	474,924	BTU/HR
Electric load max.	42.6	KW
Incinerator waste load	120.0	LBS/DAY

BUILDING NO. 13-HDQTRS. BLDG. REGIMENTAL/BRIGADE

Domestic hot water load	45.0	GAL/DAY
Heating load	220,450	BTU/HR
Cooling load	214,365	BTU/HR
Electrical load max.	26.0	KW
Incinerator waste load	100.0	LBS/DAY

MIUS-FORT BELVOIR, VA.-PROJECT #4430

TOTAL ESTIMATED MAXIMUM DEMAND LOADS -PAGE 3

BUILDING NO. 14-FOOD SERVICE FACILITY

Domestic hot water load	5000.0	GAL/DAY
Heating load	2,556,070	BTU/HR
Cooling load	1,597,803	BTU/HR
Electrical load max.	139.0	BTU/HR
Incinerator waste load	5400	LBS/DAY

BUILDING NO. 15-UNIT CHAPEL

Domestic hot water load	16.0	GAL/DAY
Heating load	395,710	BTU/HR
Cooling load	474,307	BTU/HR
Electrical load max.	18.2	KW
Incinerator waste load	40	LBS/DAY

BUILDING NO. 16-GYMNASIUM

Domestic hot water load	1400.0	GAL/DAY
Heating load	2,078,385	BTU/HR
Cooling load	0	BTU/HR
Electrical load max.	91.61	KW
Incinerator waste load	200	LBS/DAY

AMERICAN HYDROTHERM CORPORATION
NEW YORK, N. Y.

BY LM DATE 7/26/76 SUBJECT FT. BELVOIR - MIUS SHEET NO. ____ OF ____
CHKD. BY ____ DATE ____ PUMP SPECIFICATIONS JOB NO. ____

HOT WATER & CHILLED WATER DISTRIBUTION PUMPS

A- STEEL PIPE DISTRIBUTION SYSTEM

HOT WATER PUMPS: (4) 315 GPM @ 188 FT. HD.
WEINMAN 500 SERIES
3KB, 3500 RPM, 30 HP

CHILLED WATER PUMPS:
(2) 1870 GPM @ 162 FT. HD.
WEINMAN 1200 SERIES
8LI, 1750 RPM, 100 HP

B- ALTERNATE - BONDSTRAND PLASTIC PIPE

HOT WATER PUMPS: (4) 315 GPM @ 137 FT. HD.
WEINMAN 500 SERIES
3KHB, 1750 RPM, 20 HP

CHILLED WATER PUMPS:
(2) 1870 GPM @ 194 FT. HD.
WEINMAN 1200 SERIES
8LI, 1750 RPM, 125 HP

AMERICAN HYDROTHERM CORPORATION

NEW YORK, N. Y.

FIG No. 5

BY LM DATE 7/26/76 SUBJECT FT. BELVOIR - MIUS ~~SHEET NO~~ OF

CHKD. BY DATE DISTRIBUTION SYSTEM JOB NO AM-1853

PRESSURE DROPS

FROM / TO	STEEL PIPE		BONDSTRAND	
	PRESSURE DROP FT.		PRESSURE DROP FT.	
	HEATING	COOLING	HEATING	COOLING
TUS - A	0.4	1.5	0.3	1.1
A - B	5.2	7.0	3.1	4.9
B - F	0.9	1.3	0.6	0.8
F - H	4.2	2.6	1.2	3.8
H - J	10.3	6.6	2.8	18.8
J - L	5.9	7.3	3.3	—
L - 10	5.3	6.6	3.0	—
J - K	—	—	—	10.7
K - 2	—	—	—	3.8
TOTAL SUPPLY	32.2	32.9	14.3	43.9
TOTAL RETURN	32.2	32.9	14.3	43.9
TOTAL FOR PIPE	64.4	65.8	28.6	87.8
ADD 30% FOR FITT.	19.3	19.7	8.6	26.3
TOTAL FOR PIPE & FITTINGS	83.7	85.5	37.2	114.1
EQUIPMENT ROOM:				
PIPING	25	25	25	25
CONTROL VALVE	12	12	12	12
HEAT EXCH.	10	—	10	—
TUS:				
PIPING	30	25	30	25
HEAT EXCH.	10	—	10	—
SUB TOTAL	170.7	147.5	124.2	176.1
ADD 10%	17.0	14.8	12.4	17.6
TOTAL	187.7	162.3	136.6	193.7

FT. BELVOIR - MIUS

FIG NO. 3 - DISTRIBUTION PIPING PRESSURE DROP - STEEL PIPE

7/26/76

FROM TO	HOT WATER SYSTEM - 200 F AVG. HEATING LOAD FLOW LBS/HR WITHOUT DIVERSITY	HEATING LOAD FLOW LBS/HR WITH DIVERSITY	PIPE SIZE	WATER VELOCITY FT/SEC	PRESSURE DROP FT/100'	LENGTH FT	TOTAL PRESSURE DROP FT.	CHILLED WATER SYSTEM - 50 F AVG. COOLING LOAD FLOW LBS/HR WITHOUT DIVERSITY	COOLING LOAD FLOW LBS/HR WITH DIVERSITY	PIPE SIZE	WATER VELOCITY FT/SEC	PRESSURE DROP FT/100'	LENGTH FT	TOTAL PRESSURE DROP FT
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10-L	13,991	10,978	2	2.8	1.6	330	5.3	22,564	19,179	2½	3.2	2	330	6.6
4-L	40,274	31,128	2½	5.4	4.5	45	2	86,317	73,369	4	4.5	2	45	0.9
L-J		51,252	3	4.6	2.5	235	5.9		105,496	4	5.4	3.1	235	7.3
11-J	18,173	14,264	2	3.7	2.7	175	4.7	23,547	20,015	2½	3.2	1.8	175	3.2
2-K	40,219	31,084	3	3.6	1.5	320	4.8	85,556	72,723	4	4.5	2	320	6.4
3-K	40,278	31,131	2½	5.4	4.5	95	4.3	85,831	72,956	4	4.5	2	95	1.9
K-J		71,362	4	3.8	1.3	255	3.3		158,554	5	5.2	2.1	255	5.4
5-J	54,134	41,810	3	4.9	2.7	40	1.1	115,880	98,498	4	5.8	3.2	40	1.3
J-H		178,688	5	5.7	2.2	470	10.3		382,563	8	5.1	1.4	470	6.6
G-H	26,766	20,696	2	5.0	4.7	45	2.1	55,463	47,144	3	4.9	3.1	45	1.4
H-F		199,384	5	6.7	2.8	150	4.2		429,707	8	5.6	1.7	150	2.6
9-G	13,991	10,978	2	2.8	1.6	250	4.0	17,909	15,223	2	3.7	3.1	250	7.8
1-G	40,219	31,084	2½	5.4	4.5	80	3.6	85,556	72,723	4	4.5	2	80	1.6
G-F		51,197	3	4.6	2.5	230	5.8		100,779	4	5.2	2.6	230	6
F-B		250,581	6	5.6	1.7	55	0.9		530,486	8	7.0	2.4	55	1.3
8-D	10,968	8,560	1½	3.5	3.3	25	0.8	27,524	23,395	2½	3.4	2.1	25	0.5
7-D	4469	3,503	1¼	2	1.4	55	0.8	12,704	10,798	1½	4.1	5.2	55	2.9
15-D	13,190	10,552	2	2.8	1.6	475	7.6	43,119	36,651	3	3.8	1.8	475	8.6
O-C		25,253	2½	3.4	1.8	300	5.4		77,312	4	4.0	1.6	300	4.8
12-E	14,623	11,642	2	2.8	1.6	230	3.7	43,175	36,699	2½	5.7	5.8	230	13.3
13-E	7,348	5,878	1¼	3.3	3.5	135	4.7	19,488	16,565	2	3.9	3.5	135	4.7
E-C		20,501	2	4.0	3.2	65	2.1		59,740	3	5.4	3.9	65	2.5
14-C	108,341	83,201	4	5.4	2.5	70	1.8	145,255	123,467	5	4.9	1.7	70	1.2
B-C		128,955	4	6.4	3.5	145	5.1		260,519	6	5.8	2.1	145	3
B-A		379,536	6	8.6	3.7	140	5.2		791,005	8	10.0	5.0	140	7.0
16-A	74,833	59,033	4	3.9	1.4	655	9.2	-0-	-0-	—	—	—	655	—
A-TUS		438,569	8	5.6	1.2	30	0.4		791,005	8	10.0	5.0	30	1.3

FT. BELVOIR - MIUS

FIG No. 4 - DISTRIBUTION PIPING PRESSURE DROP - BONDSTRAND PIPE

7/26/76

FROM TO	HOT WATER SYSTEM - 200 F AVG. HEATING LOAD FLOW GPM WITHOUT DIVERSITY	FLOW GPM WITH DIVERSITY	PIPE SIZE	WATER VELOCITY FT/SEC	PRESSURE DROP FT/100'	LENGTH FT.	TOTAL PRESSURE DROP FT.	CHILLED WATER SYSTEM - 50 F AVG. COOLING LOAD FLOW GPM WITHT DIVERSITY	[illegible]	PIPE SIZE	WATER VELOCITY FT/SEC	PRESSURE DROP FT/100'	LENGTH FT.	TOTAL PRESSURE DROP FT.
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
10-L	29	23	2	2.3	0.9	330	3	50	38	2	3.5	2.0	330	6.6
4-L	83	64	3	3.1	0.9	45	0.4	190	147	4	3.8	1.1	45	0.5
L-J		106	3	3.9	1.4	235	3.3	240	211	4	4.7	1.6	235	3.8
11-J	37	29	2	2.8	1.3	175	2.3	52	40	2	3.5	2.0	175	3.5
2-K	83	64	3	3.1	0.9	320	2.9	188	145	4	3.8	1.2	320	3.8
3-K	83	64	3	3.1	0.9	95	0.9	188	146	4	3.8	1.1	95	1.0
K-J		147	4	3.2	0.8	255	2.0	376	317	4	9.2	4.2	255	10.7
5-J	112	86	3	4.0	1.4	40	0.6	255	197	4	4.9	1.7	40	0.7
J-H		368	6	3.8	0.6	470	2.8	923	765	8	10	4.0	470	18.8
6-H	55	43	2	4.3	2.8	45	1.3	122	94	3	4.0	1.6	45	0.7
H-F		411	6	4.2	0.8	150	1.2	1045	859	8	9.5	2.5	150	3.8
9-G	29	23	2	2.3	0.9	250	2.3	39	30	2	2.8	1.4	250	3.5
1-G	83	64	3	3.1	0.9	80	0.7	188	145	4	3.8	1.1	80	0.9
G-F		106	3	3.9	1.4	230	3.2	227	202	4	4.4	1.4	230	3.2
F-B		517	6	5.0	1.1	55	0.6	1272	1081	8	8	1.5	55	0.8
8-D	27	18	2	2.3	0.9	25	0.2	60	47	2	4.3	3.0	25	0.8
7-D	9	7	1¼ *	2	1.8	55	0.7	19	22	2	2.3	1.0	55	0.6
15-D	27	22	2	2.3	0.9	475	4.3	63	73	3	3.1	1.1	475	5.2
D-C		52	3	1.9	0.4	300	1.2	142	155	4	3.4	0.9	300	2.7
12-E	30	24	2	2.3	0.9	230	2.1	95	73	3	3.1	1.1	230	2.5
13-E	15	12	1¼ *	3.3	3.2	135	4.3	43	33	2	3.2	1.7	135	2.3
E-C		42	2	3.4	1.7	65	1.1	138	119	3	4.5	2.0	65	1.3
14-C	223	172	4	4.8	1.5	70	1.1	320	247	4	6.4	2.9	70	2.0
B-C		266	4	5.7	2.1	145	3.0	600	521	6	5.1	1.2	145	1.7
B-A		783	6	7.5	2.2	140	3.1	1872	1582	8	11.0	3.5	140	4.9
16-A	154	122	4	2.7	0.55	655	3.6	⊖	⊖	—	—	—	655	—
A-TUS		904	8	5.4	0.9	30	0.3	1872	1582	8	11.0	3.5	30	1.1

* STEEL PIPE SIZE, BONDSTRAND NOT MADE UNDER 2"

Approved by TM 5/15/76
REV RM 5/29/76
REV BD 6/1/76

MIUS FORT BELVOIR, VA #4430
COMPUTER LOADING AND
SUMMARY TAKE-OFF DATA

BUILDING DESIGNATION AND TYPE	TOTAL WALL AREA NW	NE	SW	SE	TOTAL GLASS AREA NW	NE	SW	SE	TOTAL INSUL. PNL. AREA NW	NE	SW	SE	TOTAL LIGHTS KW	TOTAL FCU NO	WATTS	TOTAL MISC MOTORS KW.	NO. OF PEOPLE	TOTAL SOLAR LOAD ROOF	NW GLASS	NE GLASS	SW GLASS	SE GLASS	SOLAR LOAD % GLASS NW	NE	SW	SE	ROOF	TOTAL HEATING	TOTAL SENS COOLING	TOTAL LAT. COOLING	TOTAL COOLING	ROOF AREA
1 EM BARRACKS BUILDING (3) MODULES (BCD)(BCD)(ACD)	5286	3672	3672	5286	635	1998	1998	947	317	759	891	346	18.0	89	1428	15.5	140	79047	25410	63936	213543	32198	6	15	52	8	19	988330	748312	192806	941118	10740
2 EM BARRACKS BUILDING (3) MODULES (BCD)(BCD)(ACD)	5286	3672	3672	5286	635	1998	1998	947	317	759	891	346	18.0	89	1428	15.5	140	79047	25410	63936	213543	32198	6	15	52	8	19	988330	748312	192806	941118	10740
3 EM BARRACKS BUILDING (3) MODULES (BCD)(ACD)(BCD)	5286	3672	3672	5286	739	1998	1998	843	346	891	891	337	18.0	89	1428	15.5	140	79047	29572	63936	213543	28674	7	15	52	7	19	970080	751631	192512	944143	10740
4 EM BARRACKS BUILDING (3) MODULES (BCD)(ACD)(BCD)	5286	3672	3672	5286	635	1998	1998	947	317	891	891	346	18.0	89	1428	15.5	140	79047	25400	63936	213543	32198	7	15	52	7	19	989960	756975	192512	949487	10740
5 EM BARRACKS BUILDING (4) MODULES (ACD)(ACD)(BCD)(BCD)	6797	4896	4896	6797	1224	2664	2664	1017	442	1188	1188	424	23.8	118	1991	22.0	184	105395	48988	85248	284124	34564	9	15	51	6	19	1324615	1016449	258228	1274677	14320
6 EM BARRACKS BUILDING (2) MODULES (BCD)(ACD)	3022	2448	2448	3524	612	1332	1332	508	221	594	594	212	12.0	59	945	11.0	92	52984	24480	42624	142362	17306	9	15	51	6	19	659445	482004	128916	610920	7160
7 DISPENSARY GROUP BUILDING	282	662	642	313	84	114	166	43	35	—	—	—	6.70	0	0	31.0	10	23683	3360	3648	31042	1462	5	6	49	2	38	119780	118221	21524	139745	3195
8 BRANCH EXCHANGE BUILDING	710	400	610	640	220	0	60	300	0	0	0	0	14.875	0	0	23.5	50	34978	8800	0	11220	10700	14	0	17	16	53	286191	205995	96774	302769	4720
9 3 COMPANY ADMIN. (OFF.) BUILDING #1 (STOR.)	533	1944	1256	533	0	0	252	0	0	0	220	0	15.45 9.10	0	0	2.23 4.10	45	39975	0	0	0	11764	0	0	0	23	77	141206 235675	163530 NONE	33465 NONE	196995 NONE	5402 8640
10 3 COMPANY ADMIN. (OFF.) BUILDING #2 (STOR.)	1944	533	533	1256	0	0	0	252	0	0	0	220	15.45 9.10	0	0	2.23 4.10	45	39975	0	0	64702	0	0	0	61	0	39	141206 235675	214739 NONE	33465 NONE	248204 NONE	5402 8640
11 4 COMPANY ADMIN (OFF.) BUILDING (STOR.)	1674	533	533	2542	336	0	0	0	274	0	0	0	20.60 10.30	0	0	2.98 5.50	60	51150	18480	0	0	0	27	0	0	0	73	183560 306885	214400 NONE	44620 NONE	259020 NONE	6910 11640
12 TWO BATTALION HDQTRS & CLASSROOM BUILDING	1255	1804	2029	1255	201	510	290	201	0	0	0	0	25.50	0	0	1.32 12.1	96	82724	8040	16320	27438	6830	6	11	19	5	59	427270	366629	108295	474924	11989
13 HEADQUARTERS BLDG REGIMENTAL/BRIGADE	2060	720	720	1600	236	96	96	402	104	52	52	78	15.30	23	45	2.5 10.7	45	23552	9440	3072	17953	13670	14	5	27	20	34	220450	178405	35960	214365	3200
14 FOOD SERVICE FACILITY BUILDING *	1493 965 C	1500 0 C	1259 1259 C	1493 965 C	230 230 C	298 0 C	666 666 C	230 230 C	0	0	0	0	34.85 (9.00)	0	0	45.84 39.5 (60.6)	340	53406	9200	0	75591	7820	6	0	52	5	37	556070	868503	729300	1597803	15172/9675 C
15 UNIT CHAPEL BUILDING	1470	1744	1859	1223	381	442	332	128	0	0	0	0	7.70	18	131	1.55 10.5	308	39946	12195	11315	49670	3480	11	10	42	3	34	395710	329767	144540	474307	8684
16 GYMNASIUM BUILDING (NO COOLING SYSTEM)	4950	3627	3554	4652	110	37	110	161	0	0	0	0	51.80	0	0	0 39.81	0						2	1	10	3	84	2078385				21357
																												13268825	7163872	2405723	9242440	179391

353.425 TOTAL
(249.175 TOTAL KW COOLING ONLY)
- 244.74 KW COOLING ONLY
= 835,787 BTU/HR OR 69.65 TONS

* C = COOLED AREA ONLY

add SF = 180,000 ft³ x 1.4 x 4°F
= 1008,000 BTU/HR / 12000/TON
= 84.0 TONS

7163872
2405723
9569595
-327157 KW DEDUCTIONS
9242438 BTU/HR TOTAL / 12000
= 770.20 TONS
-84.0 TONS STOR. FACTOR
686.20
-115.00 change in ...
571.0 TONS

Page

3.0. Profiles and Tables - Index........................ 206

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By AM Date 7-15-76 Sheet ____ of ____
Chkd. By ____ Date ____ Job No. 4430

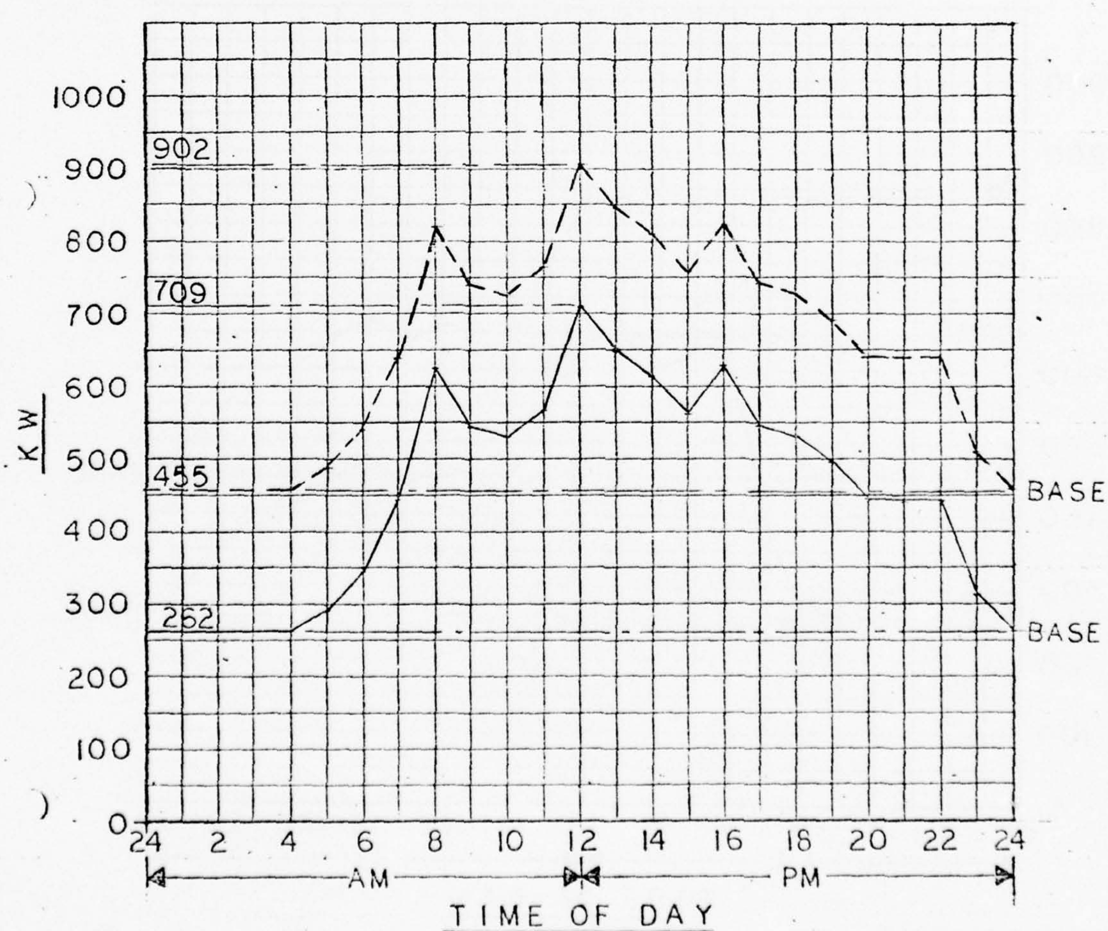
Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO I THRU 16

For ELECTRICAL PROFILE COMPOSITE JANUARY 22 & 23

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO I THRU 16

- - - - TOTAL KW LOAD BUILDINGS NO I THRU 16 TUS PLANT AND SEWAGE TREATMENT



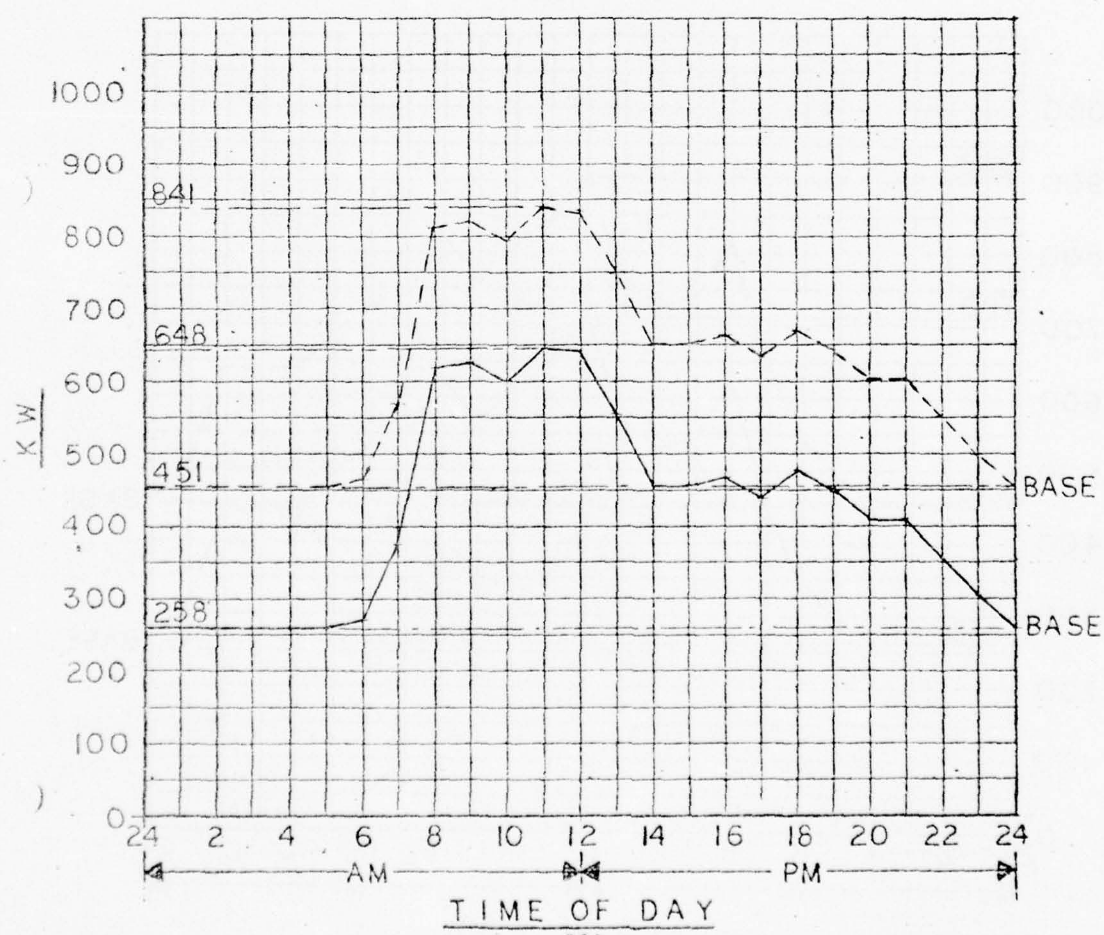
GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
206 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By AM Date 7-15-76 Sheet ____ of ____
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO I THRU 16
For ELECTRICAL PROFILE COMPOSITE
JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO I THRU 16
- - - - TOTAL KW LOAD BUILDINGS NO I THRU 16 TUS PLANT AND SEWAGE TREATMENT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By AM Date 7-15-76
Chkd. By ______ Date ______
Sheet ______ of ______
Job No. 4430

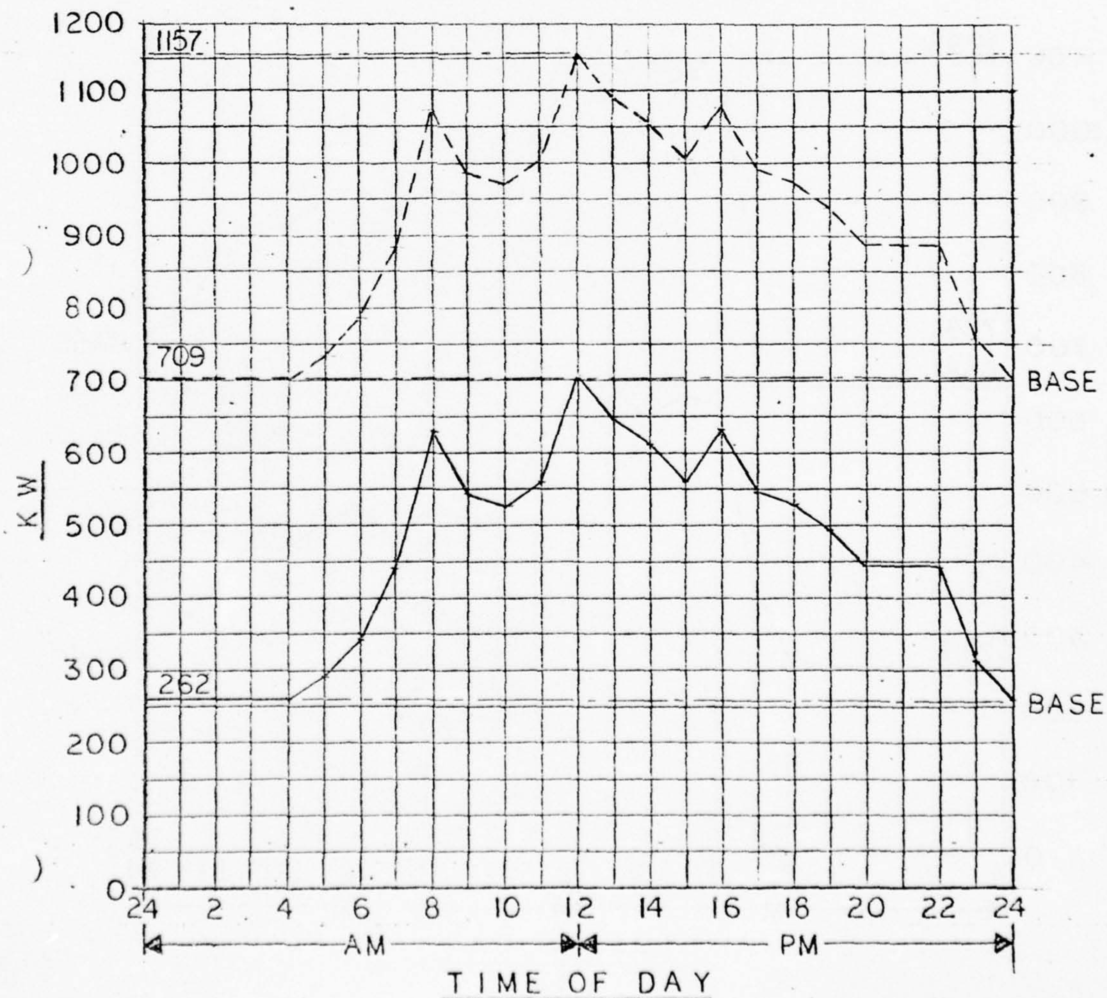
Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO I THRU 16

For ELECTRICAL PROFILE COMPOSITE
AUGUST 19 & 20

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO I THRU 16

- - - - TOTAL KW LOAD BUILDINGS NO I THRU 16
TUS PLANT AND SEWAGE TREATMENT



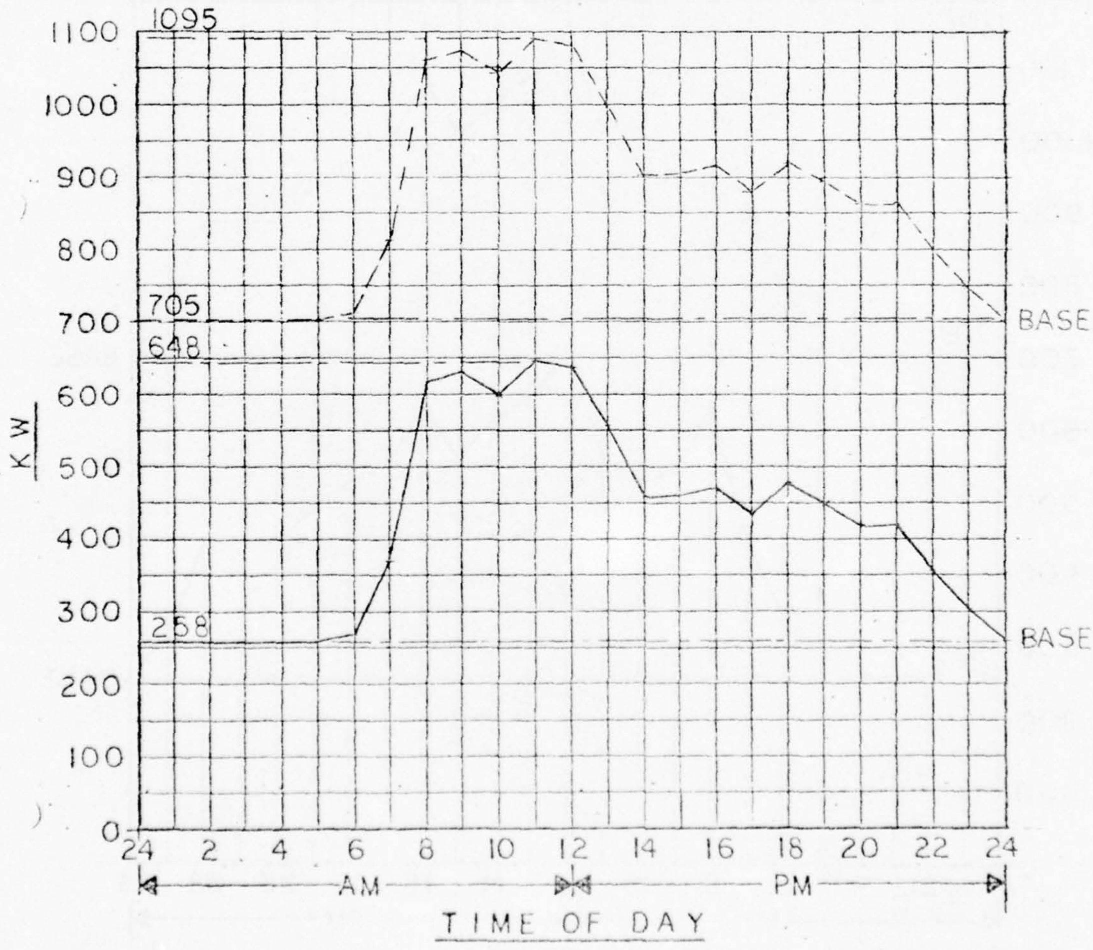
GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By AM Date 7-15-76 Sheet ___ of ___
Chkd. By ___ Date ___ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND
For ELECTRICAL PROFILE COMPOSITE BUILDINGS NO I THRU 16
AUGUST 21

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL KW LOAD - BUILDINGS NO I THRU 16
– – – – TOTAL KW LOAD BUILDINGS NO I THRU 16
TUS PLANT AND SEWAGE TREATMENT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

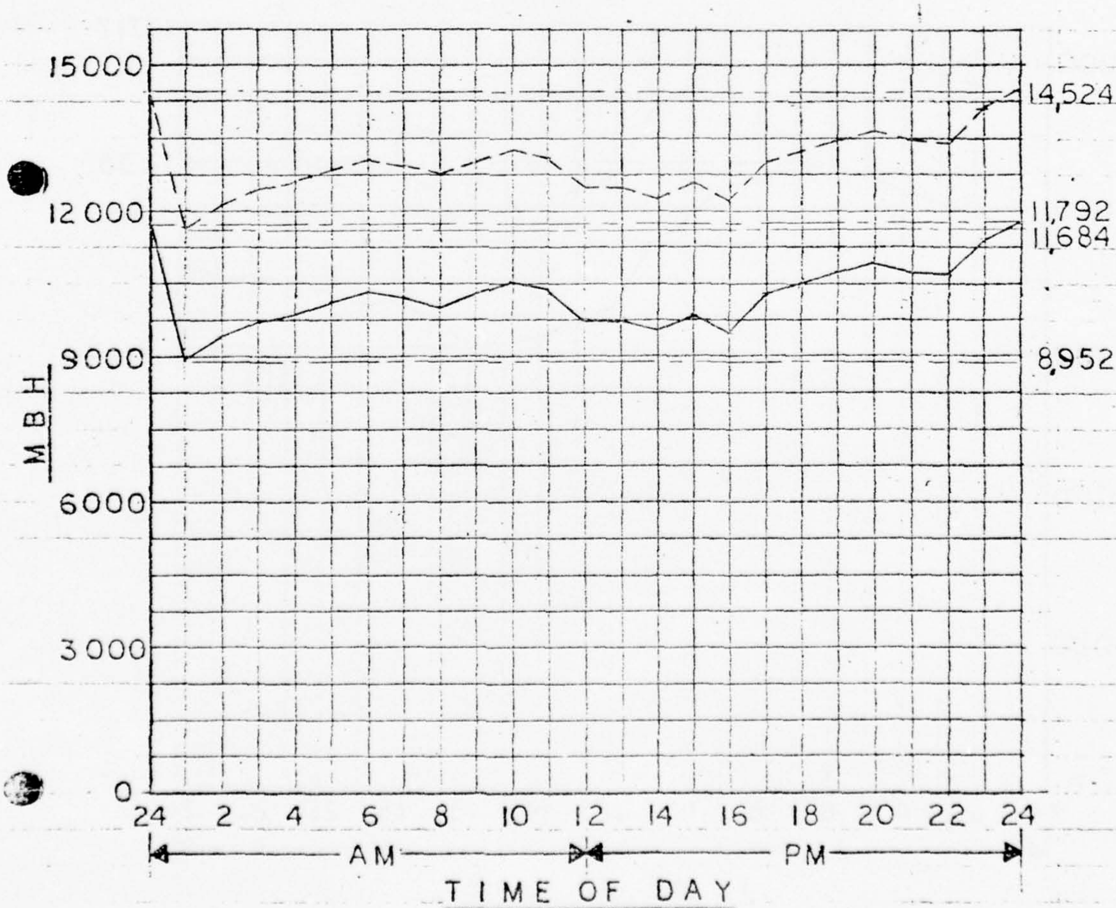
Comp. By AM Date 7-15-76 Sheet ___ of ___
Chkd. By ___ Date ___ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO 1 THRU 16
For HEATING PROFILE COMPOSITE
JANUARY 22

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL MBH LOAD BUILDINGS NO 1 THRU 16

– – – – TOTAL MBH LOAD BUILDINGS NO 1 THRU 16 TUS PLANT AND SEWAGE TREATMENT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

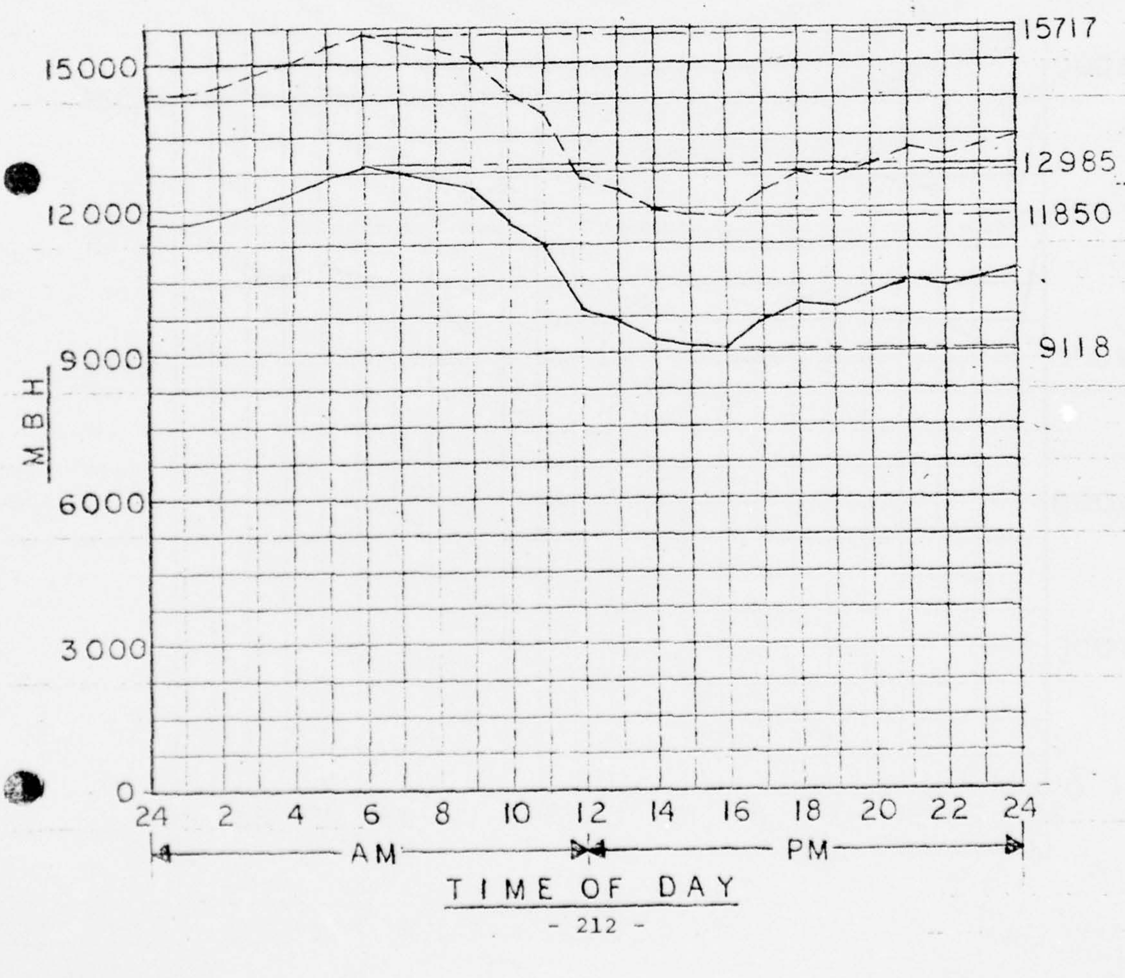
Comp. By AM Date 7-15-76 Sheet ____ of ____
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO 1 THRU 16
For HEATING PROFILE COMPOSITE
JANUARY 23

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL MBH LOAD BUILDINGS NO 1 THRU 16

– – – TOTAL MBH LOAD BUILDINGS NO 1 THRU 16 TUS PLANT AND SEWAGE TREATMENT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

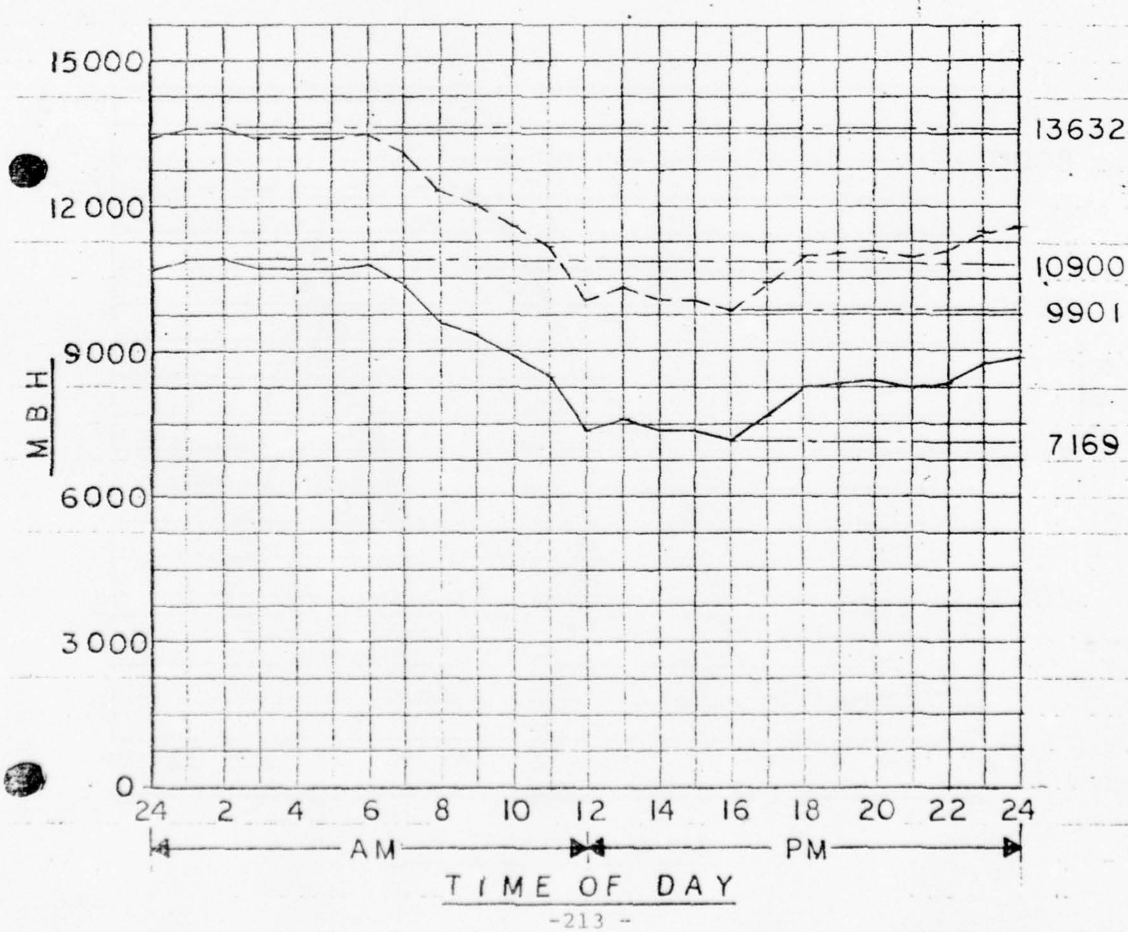
Comp. By AM Date 7-16-76 Sheet ___ of ___
Chkd. By ___ Date ___ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO 1 THRU 16
For HEATING PROFILE COMPOSITE
JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

——— TOTAL MBH LOAD BUILDINGS NO 1 THRU 16

– – – TOTAL MBH LOAD BUILDINGS NO 1 THRU 16 TUS PLANT AND SEWAGE TREATMENT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
203 W227 WACKER DRIVE
CHICAGO, ILLINOIS 60606

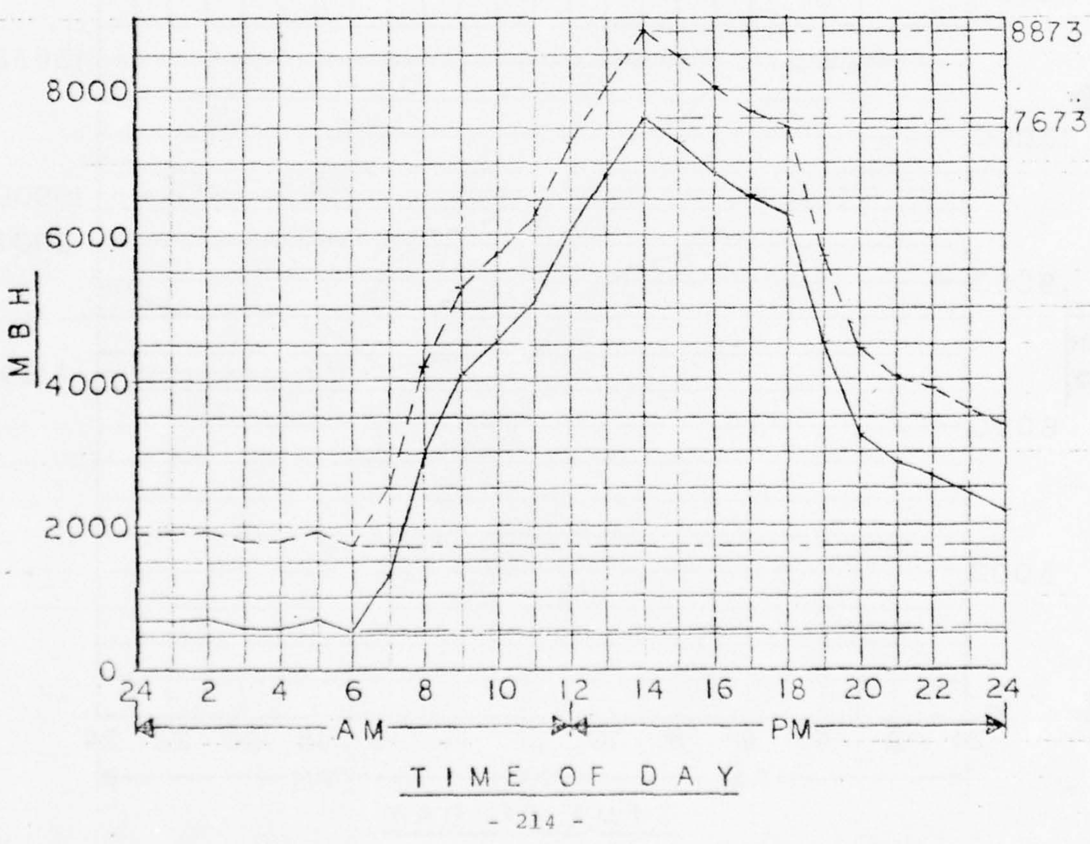
Comp. By A M Date 7-16-76
Chkd. By ______ Date ______
Sheet ______ of ______
Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND BUILDINGS NO 1 THRU 16
For COOLING PROFILE COMPOSITE
AUGUST 19

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16

– – – – – TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16 & TUS PLANT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
203 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

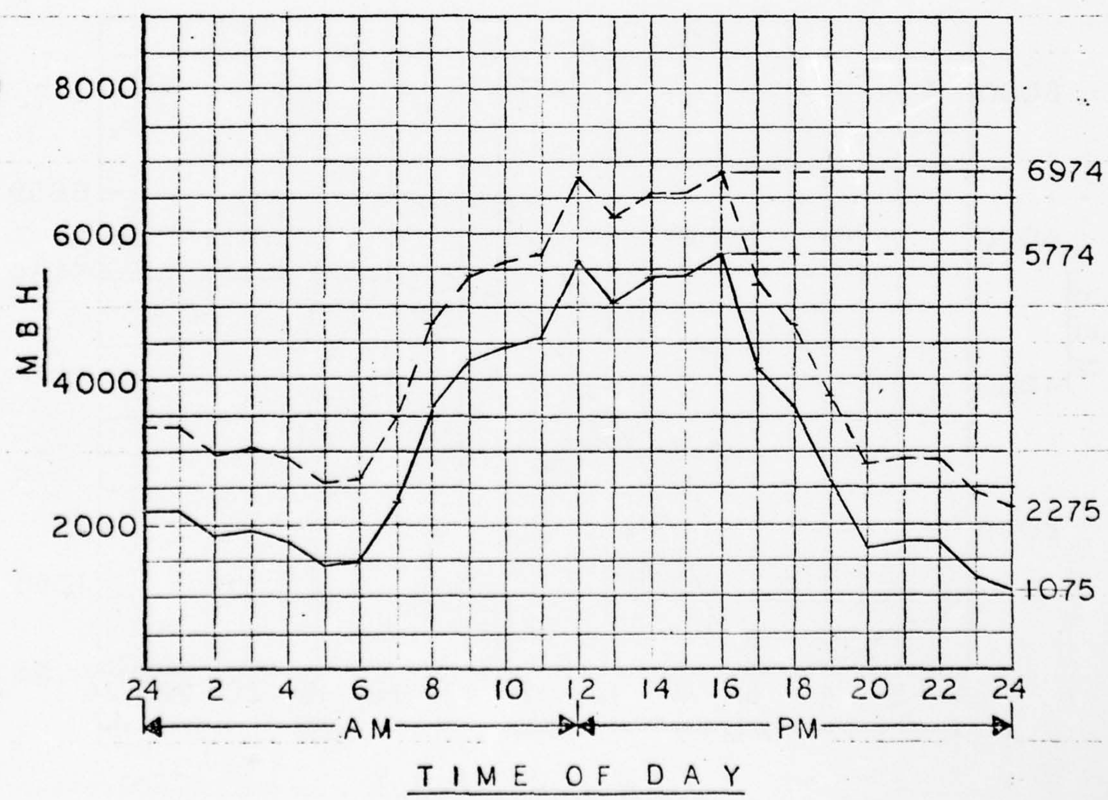
Comp. By A M Date 7 16 76 Sheet ____ of ____
Chkd. By ____ Date ____ Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND
For COOLING PROFILE COMPOSITE BUILDINGS NO 1 THRU 16
AUGUST 20

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16

– – – – – TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16 & TUS PLANT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
209 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

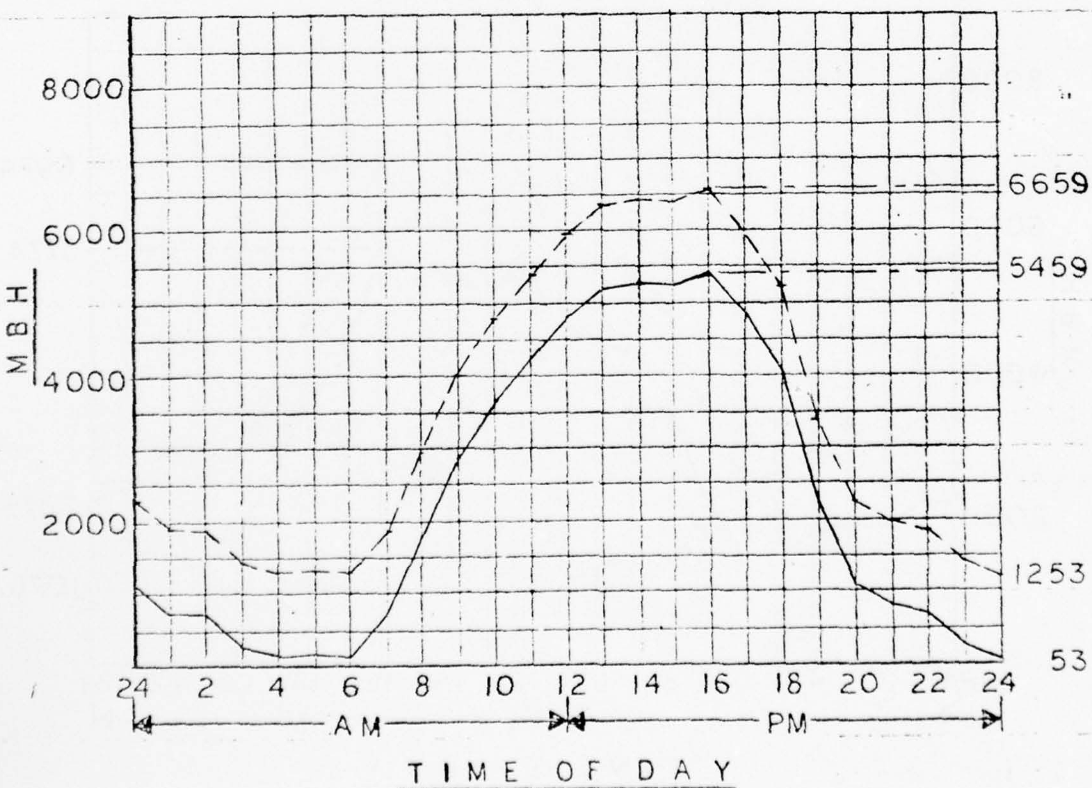
Comp. By AM Date 7-16-76 | Sheet ____ of ____
Chkd. By ____ Date ____ | Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure TUS BUILDING AND
For COOLING PROFILE COMPOSITE BUILDINGS NO 1 THRU 16
AUGUST 21

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA

———— TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16

– – – – TOTAL MBH LOAD - BUILDINGS NO 1 THRU 16 & TUS PLANT



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By A M Date 7-20-76

Chkd. By ______ Date ______

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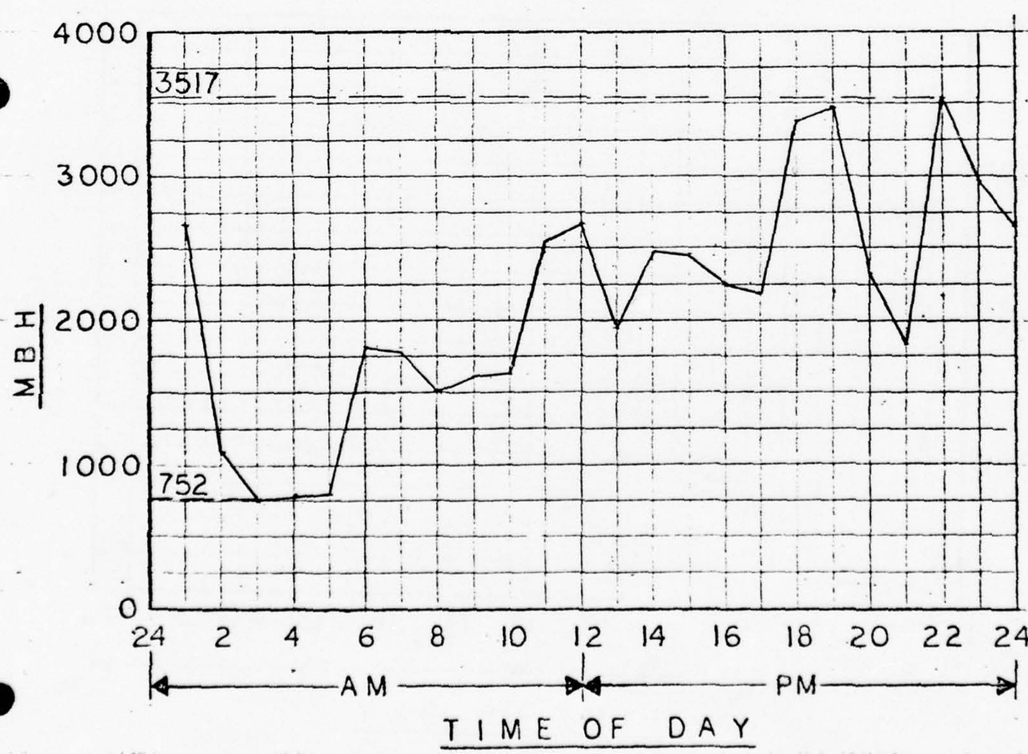
Job No. 4430

Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO I THRU 6, 14 & 16 ONLY

For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE JANUARY 22 & 23

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



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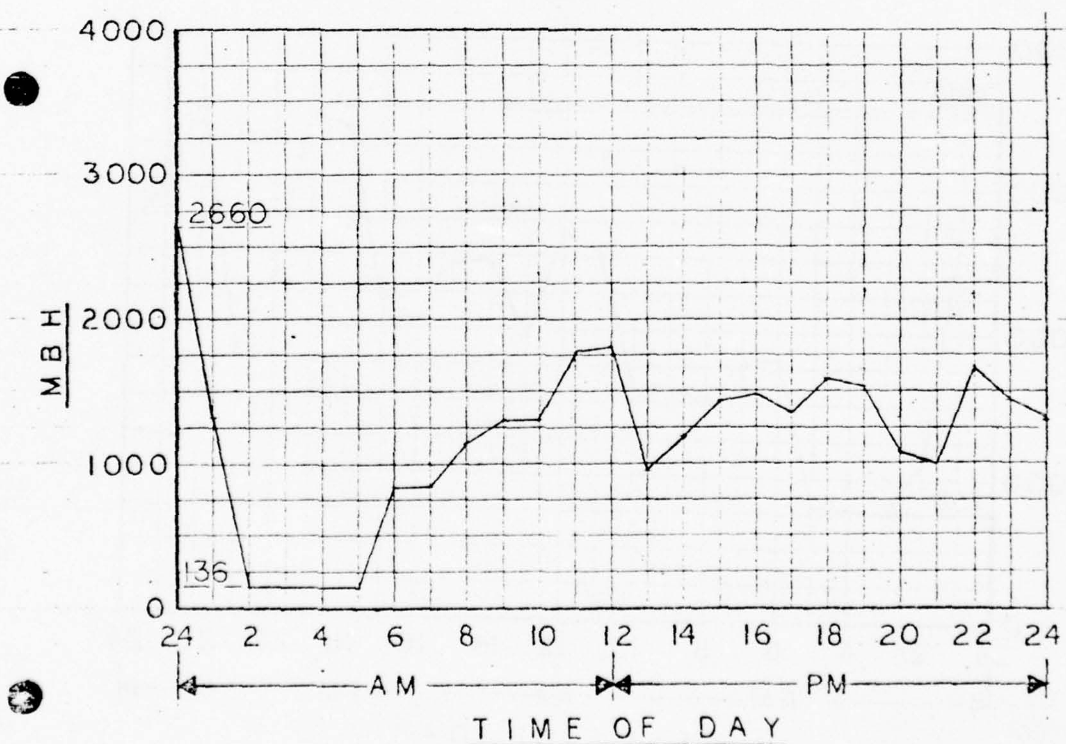
Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONLY
For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE
JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454 DATA



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208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

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Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONLY
For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE
AUGUST 19 & 20

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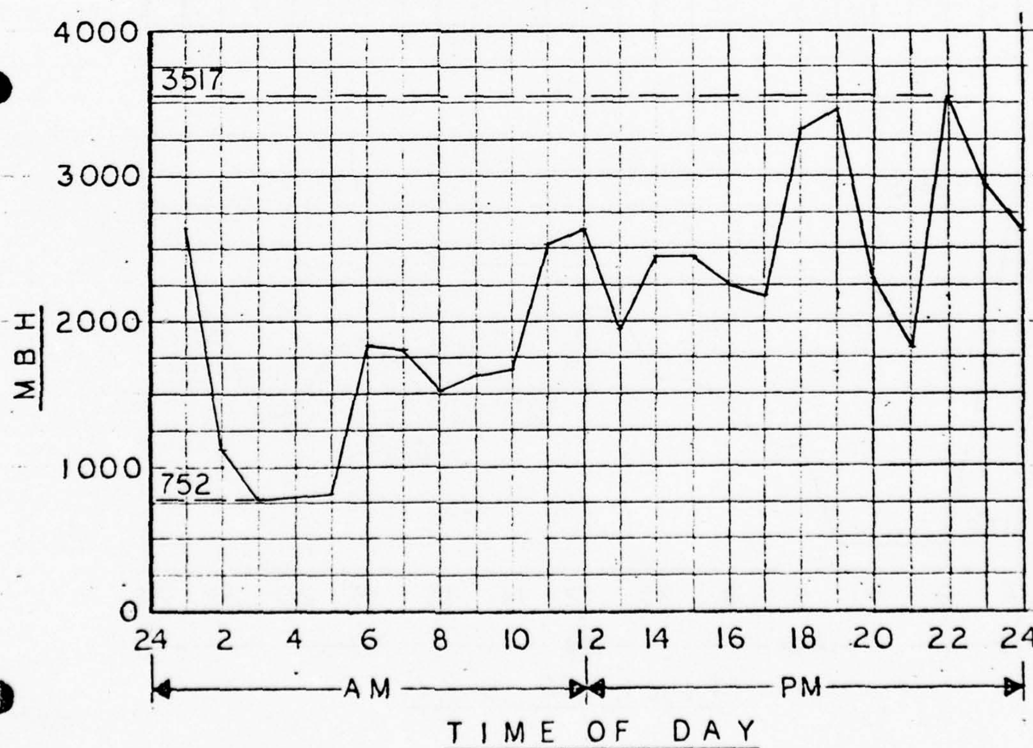

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Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 1 THRU 6, 14 & 16 ONLY

For INDIRECT (DOMESTIC HW) PROCESS PROFILE - COMPOSITE AUGUST 21

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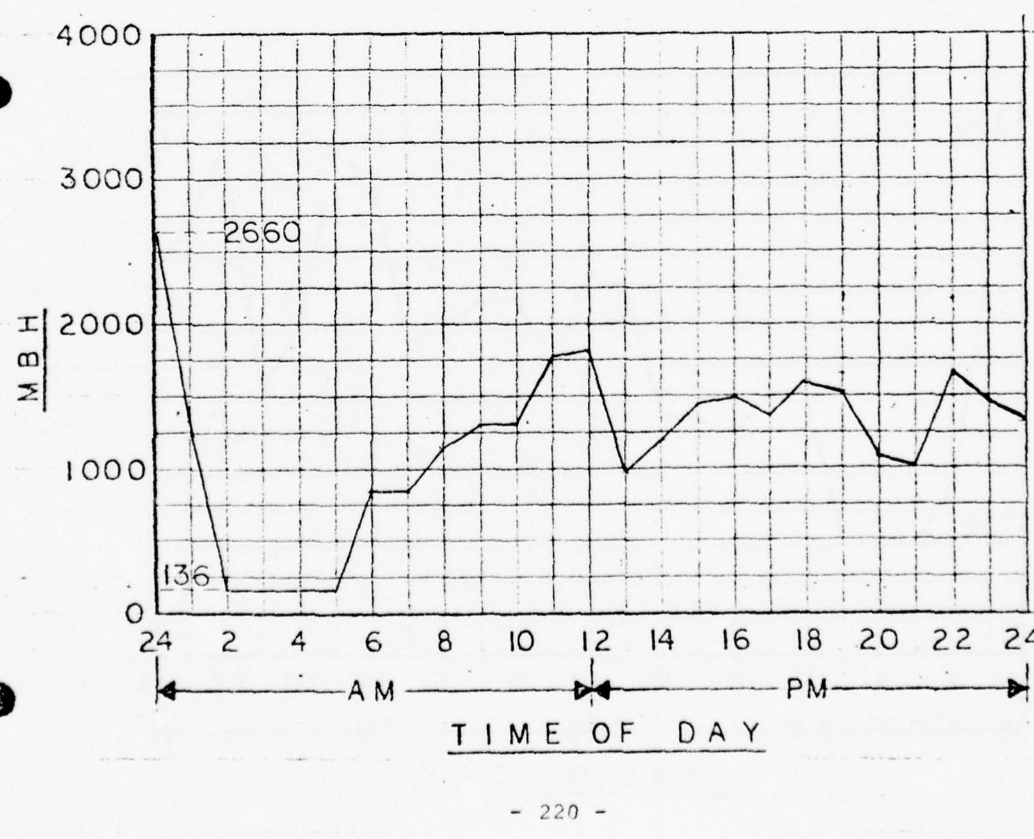

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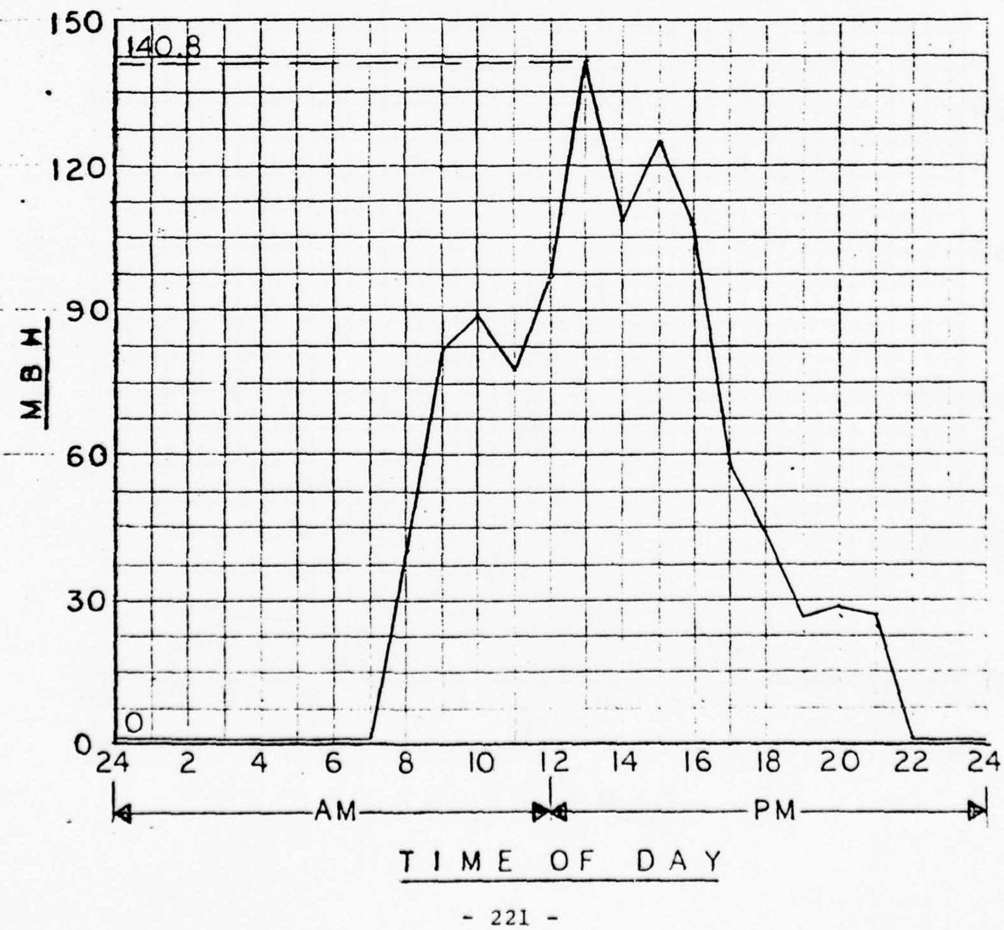
Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 7 THRU 13 & 15 ONLY
For DIRECT (DOMESTIC HW ELECTRIC) PROCESS PROFILE - COMPOSITE
JANUARY 22 & 23

PEAK CONDITIONS FROM WEATHER TAPE 15454



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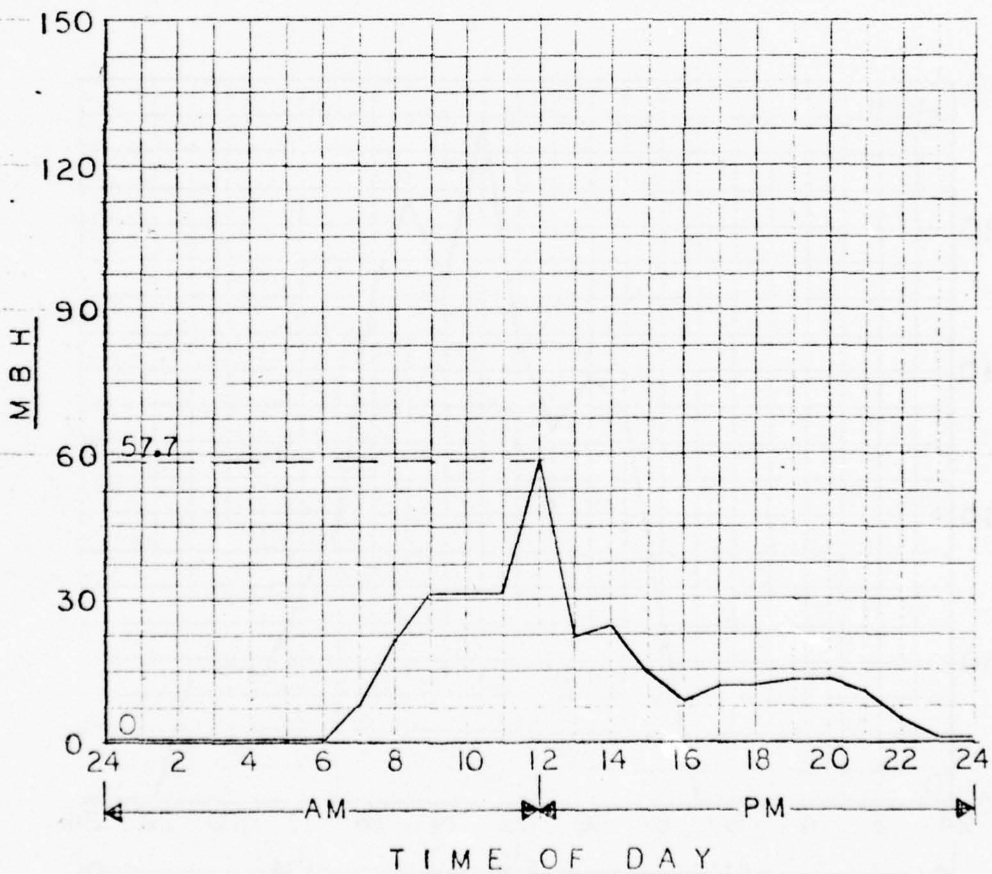
Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 7 THRU 13 & 15 ONLY

For DIRECT (DOMESTIC HW ELECTRIC) PROCESS PROFILE - COMPOSITE

JANUARY 24

PEAK CONDITIONS FROM WEATHER TAPE 15454



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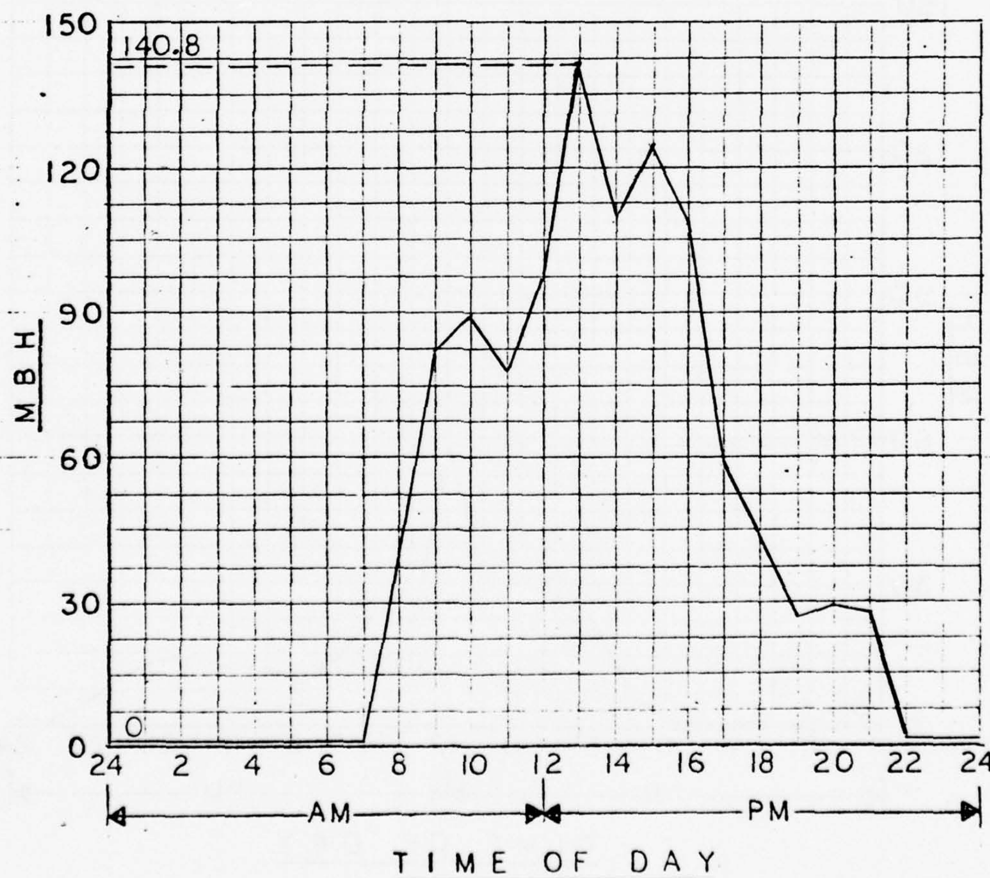
Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 7 THRU 13 & 15 ONLY

For DIRECT (DOMESTIC HW ELECTRIC) PROCESS PROFILE - COMPOSITE
AUGUST 19 & 20

PEAK CONDITIONS FROM WEATHER TAPE 15454



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205 WEST WACKER DRIVE
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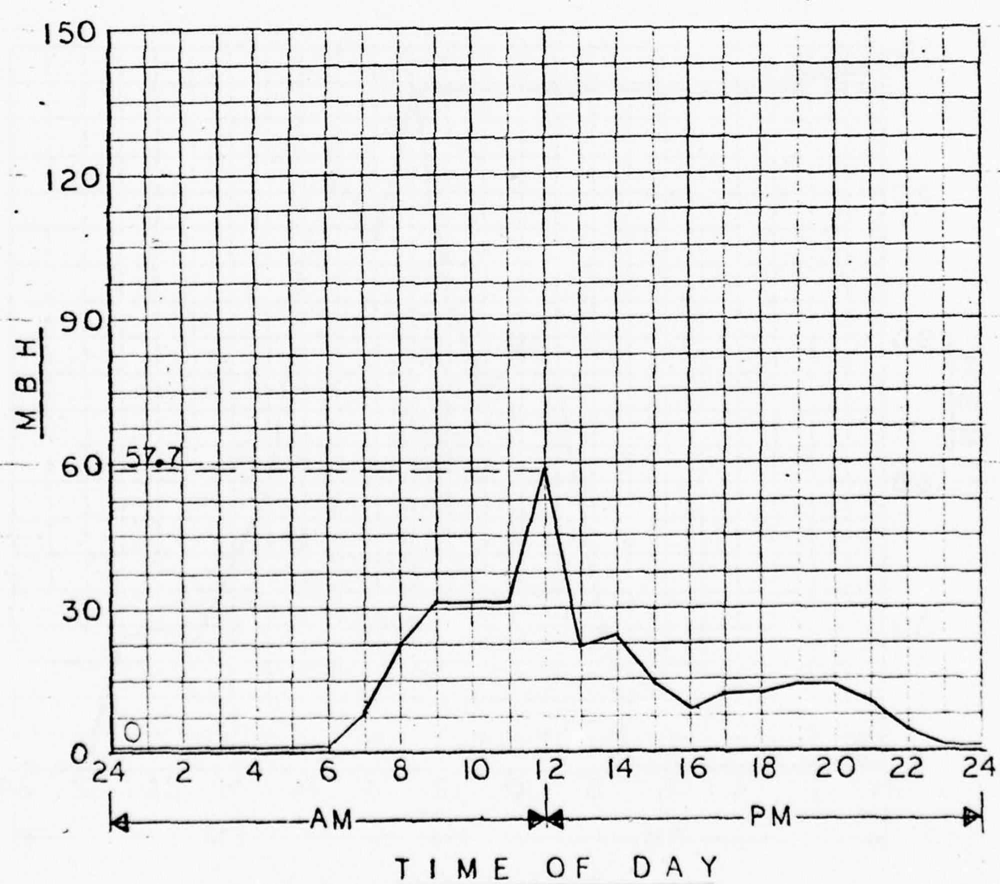
Project MIUS FT BELVOIR, VIRGINIA Structure BLDG NO 7 THRU 13 & 15 ONLY
For DIRECT (DOMESTIC HW ELECTRIC) PROCESS PROFILE - COMPOSITE
AUGUST 21

PEAK CONDITIONS FROM WEATHER TAPE 15454



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208 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

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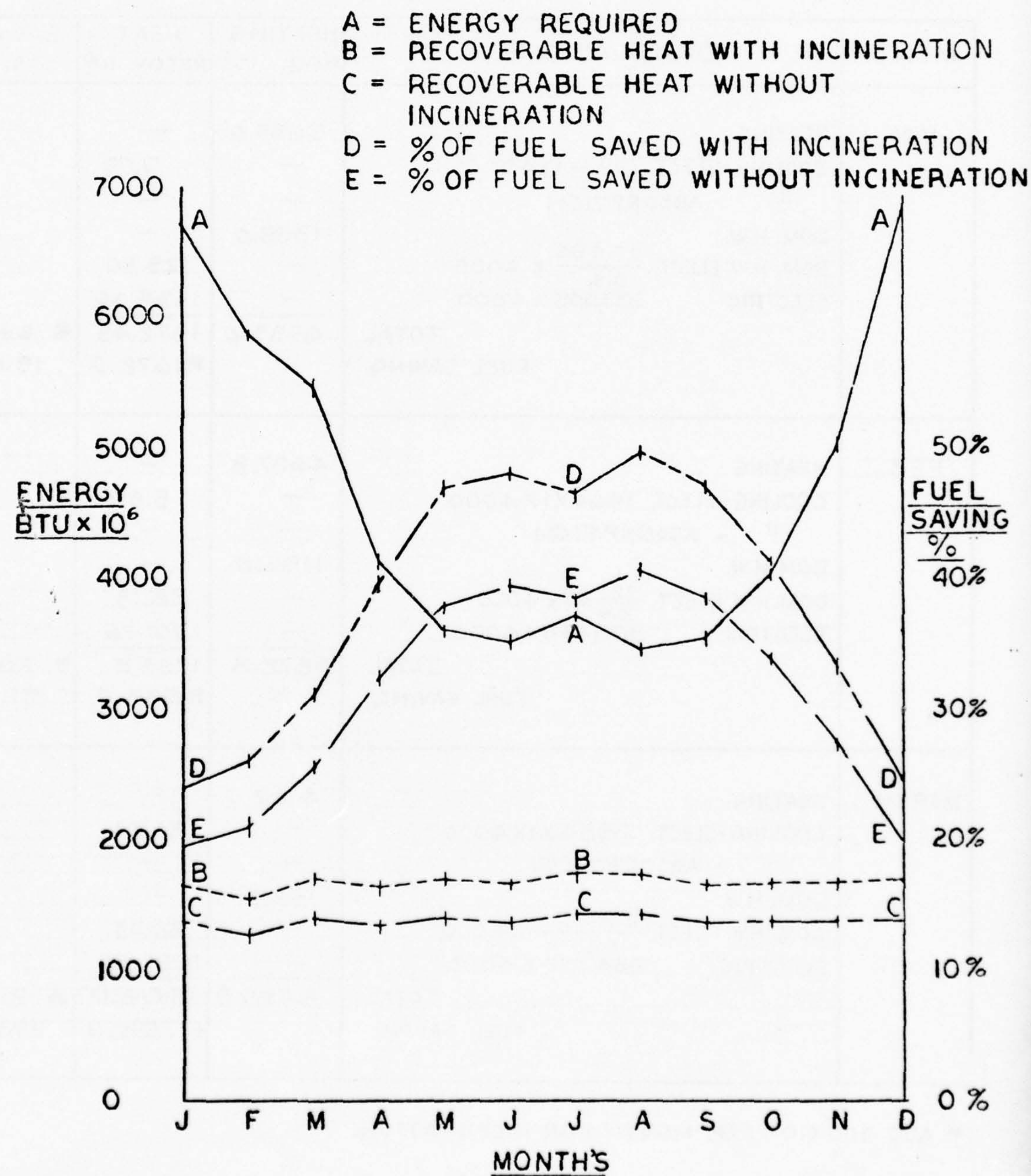
Project MIUS FT. BELVOIR, VIRGINIA Structure TOTAL SITE
For ENERGY REQUIREMENT, RECOVERABLE HEAT & FUEL SAVING'S



GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By DEF Date 8/31/76 Sheet 1 of 5
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Project MIUS FORT BELVOIR, VA. Structure ____
For FUEL SAVINGS COST ANALYSIS - TOTAL SITE

MONTH	CALCULATIONS	HEATING REQ. 10^6	HEAT RECOV. 10^6	SAVING %
JAN.	HEATING	5655.0	—	
	COOLING-ELECT. 1999X1X4000	—	7.99	
	" - ABSORPTION	—	—	
	DOM. H.W.	1338.0	—	
	DOM. H.W. ELECT. $\frac{25,456}{3.4}$ X 4000	—	29.90	
	ELECTRIC 333,668 X 4000	—	1334.60	
	TOTAL	6993.0	1372.49	* 24.0%
	FUEL SAVING		*1672.0	19.6 %
FEB.	HEATING	4687.8	—	
	COOLING-ELECT. 1464X1X4000	—	5.85	
	" - ABSORPTION	—	—	
	DOM. H.W.	1185.0	—	
	DOM. H.W. ELECT. $\frac{22,264}{3.4}$ x 4000	—	26.19	
	ELECTRIC 300,440 X 4000	—	1201.76	
	TOTAL	5872.8	1233.8	* 26.0%
	FUEL SAVING		*1533.0	21.0 %
MARCH	HEATING	4127	—	
	COOLING-ELECT. 8586X1X4000	—	34.34	
	" - ABSORPTION	—	—	
	DOM. H.W.	1362	—	
	DOM. H.W. ELECT. $\frac{26,209}{3.4}$ X 4000	—	30.83	
	ELECTRIC 334,638 X 4000	—	1338.55	
	TOTAL	5489.0	1403.0	* 31.0 %
	FUEL SAVING		*1703.0	25.5 %

* ADD 300X10^6 PER MONTH FOR INCINERATION.

GAMZE-KOROBKIN-CALOGER
CONSULTING ENGINEERS
205 WEST WACKER DRIVE
CHICAGO, ILLINOIS 60606

Comp. By DEF Date 8/31/76
Chkd. By ______ Date ______
Sheet 2 of 5
Job No. 4430

Project MIUS FORT BELVOIR, VA. Structure ______
For FUEL SAVINGS COST ANALYSIS - TOTAL SITE

MONTH	CALCULATIONS	HEATING REQ. 10^6	HEAT RECOV. 10^6	SAVING %
APRIL	HEATING	2372.4	—	
	COOLING-ELECT. .12 X 27,793 X 4000	—	13.34	
	- ABS .88 X 27,793 X 18,000	440	—	
	DOM. H.W.	1335	—	
	DOM. H.W. ELECT. $\frac{25,898}{3.4}$ X 4000	—	30.46	
	ELECTRIC 324,531 X 4000	—	1298.10	
	TOTAL	4147.4	1341.9	* 39.5 %
	FUEL SAVING		* 1641.0	32.3 %
MAY	HEATING	901	—	
	COOLING-ELECT. .12 X 88,285 X 4000	—	42.37	
	- ABS. .88 X 88,285 X 18,000	1398	—	
	DOM. H.W.	1314	—	
	DOM. H.W. ELECT. $\frac{24,703}{3.4}$ X 4000	—	29.06	
	ELECTRIC 332,699 X 4000	—	1330.70	
	TOTAL	3613	1401.43	* 47.0 %
	FUEL SAVING		* 1701.0	38.1 %
JUNE	HEATING	290	—	
	COOLING-ELECT. .12 X 118,895 X 4000	—	57.06	
	- ABS. .88 X 118,895 X 18,000	1883.3	—	
	DOM. H.W.	1335.0	—	
	DOM. H.W. ELECT. $\frac{25,898}{3.4}$ X 4000	—	30.0	
	ELECTRIC 324,531 X 4000	—	1298.0	
	TOTAL	3508.3	1385.06	* 48.0 %
	FUEL SAVING		* 1685.0	39.48 %

* ADD 300 X 10^6 PER MONTH FOR INCINERATION.

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Project MIUS FORT BELVOIR, VA. Structure ____
For FUEL SAVINGS COST ANALYSIS - TOTAL SITE

MONTH	CALCULATIONS	HEATING REQ. 10^6	HEAT RECOV. 10^6	SAVING %
JULY	HEATING	11.09	—	
	COOLING-ELECT. .12X146,628X4000	—	70.38	
	- ABS .88X146,628X18,000	2322.0	—	
	DOM. H.W.	1385.9	—	
	DOM. H.W. ELECT.	—	30.0	
	ELECTRIC 335,607X4000	—	1342.4	
	TOTAL	3718.99	1442.78	* 46.8%
	FUEL SAVING		* 1742.0	38.78%
AUG.	HEATING	77.9	—	
	COOLING-ELECT. .12X130,566X4000	—	62.67	
	- ABS. .88X130,566X18,000	2068.0	—	
	DOM. H.W.	1338.0	—	
	DOM. H.W. ELECT.	—	30.0	
	ELECTRIC 333,668X4000	—	1334.0	
	TOTAL	3483.9	1426.0	* 49.5%
	FUEL SAVING		* 1726.0	40.9%
SEPT.	HEATING	744	—	
	COOLING-ELECT. .12X92,106X4000	—	44.21	
	- ABS. .88X92,106X18,000	1458	—	
	DOM. H.W.	1335	—	
	DOM. H.W. ELECT.	—	30.0	
	ELECTRIC 324,531X4000	—	1298.0	
	TOTAL	3537.0	1372.21	* 47.3%
	FUEL SAVING		* 1672.0	38.3%

* ADD 300X10^6 PER MONTH FOR INCINERATION.

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Project MIUS FORT BELVOIR, VA. Structure ____
For FUEL SAVINGS COST ANALYSIS - TOTAL SITE

MONTH	CALCULATIONS		HEATING REQ. 10^6	HEAT RECOV. 10^6	SAVING %
OCT.	HEATING		2127	—	
	COOLING-ELECT.	.12 X 33,613 X 4000	—	8.03	
	- ABS	.88 X 33,613 X 18,000	532	—	
	DOM. H.W.		1362	—	
	DOM. H.W. ELECT.		—	30.0	
	ELECTRIC	334,638 X 4000	—	1338.0	
		TOTAL	4029.0	1376.03	* 41.6%
		FUEL SAVING		* 1676.0	34.2%
NOV.	HEATING		3713	—	
	COOLING-ELECT.	14,232 X 4000	—	56.9	
	- ABS.		—	—	
	DOM. H.W.		1287	—	
	DOM. H.W. ELECT.		—	30.0	
	ELECTRIC	322,592 X 4000	—	1290.0	
		TOTAL	5000.0	1376.9	* 33.5%
		FUEL SAVING		*1676	27.5%
DEC	HEATING		5441	—	
	COOLING-ELECT.	744 X 4000	—	2.97	
	- ABS		—	—	
	DOM. H.W.		1362	—	
	DOM. H.W. ELECT.		—	30.0	
	ELECTRIC	334,638 X 4000	—	1338	
		TOTAL	6803.0	1370.97	* 24.5%
		FUEL SAVING		*1670.0	20.1 %

* ADD 300×10^6 PER MONTH FOR INCINERATION.

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Chkd. By ________ Date ________

Job No. 4430

Project MIUS FORT BELVOIR, VA Structure ________

For FUEL SAVINGS COST ANALYSIS - TOTAL SITE

MONTH	CALCULATIONS		HEATING REQ. 10^6	HEAT RECOV. 10^6	SAVING %
TOTAL AVERAGE	HEATING		30152		
	COOLING - ELECT.	.12 X 664,668 X 4000		319	
	- ABS.	.88 X 664,668 X 18000	10528		
	DOM. H.W.		15904		
	DOM. H.W. ELECT.	$\frac{30558}{3.4}$ X 4000		359	
	ELECTRIC	3,936,179 X 4000		15744	
		AVERAGE	56584.0	16422	* 35 %
		FUEL SAVING		* 3600	29 %

* ADD 300 X 10^6 PER MONTH FOR INCINERATION.

Fort Belvoir, VA.
1200 EM Barracks

Plant Equipment Selection
and Thermal Balance

WINTER OPERATION - Jan. 23	Site Load BTU/HR	Heat Recovery BTU/HR	Usable Load Installed BTU/HR KW
1. Heating Requirement - Profile	15,717,000	-	-
2. Domestic Water Requirement - Profile	3,517,000	-	-
3. Total Site Requirement	19,224,000	-	-
4. Electric Generation Select 4-600KW diesel generators 3 on-line, 1 in reserve			1920KW
5. Heat Recovered from engines 902 x 4000	-	3,608,000	-
6. Net Heat Requirement	15,616,000	-	-
7. Select 4 boilers each 5200MBH 3 on-line, 1 in reserve	-	-	20,800,000 B/HR
SUMMER OPERATION - Aug. 19			
1. Refrigeration System - Required 970 x .7 x 12,000	8,148,000		
1-118 ton electric centrifugal unit	-	-	1,416,000 B/HR 120KW
1-620 ton absorption refrigeration unit	-	-	7,440,000 B/HR
2. Thermal Requirements 620 tons x 17,000	10,540,000		
3. Domestic Hot Water	3,500,000		
4. Total Site Requirement	14,040,000		
5. Electric Gen. Heat Recovery 1157 x 4000		4,628,000	
6. Net Thermal Requirement (Boiler)	9,412,000		
7. Total Boiler Capacity			20,800,000
8. Total Refrigeration Capacity			8,856,000

CHAPTER X

Drawings

CHAPTER X

DRAWINGS

1.0. Drawing List

SKA-1	Site Plan
SKA-2	First Floor and Roof Framing Plan
SKA-3	Roof Plan
SKA-4	Elevations
SKA-5	Cross Sections
SKA-6	Pavement & Reinforcing Plan
SKA-7	Oil Storage Tank Details
SKM-1	Site Plan and Symbol List
SKM-2	Site Heating and Cooling Water Distribution Plan
SKM-3	Partial Mechanical Equipment Rooms for Buildings No. 1 through 16 Interfacing
SKM-4	Mechanical Schedules and Interfacing Piping Diagrams
SKM-5	Mechanical Schedules
SKM-6	Total Utility System Building Floor Plans
SKM-7	Mechanical Schedules for Total Utility System Building
SKM-8	Total Utility System Hot Water Flow Diagram
SKM-9	Diesel Fuel Oil and Oil Cooler Flow Diagram
SKM-10	Chilled Water and Condenser Water Flow Diagram
SKM-11	Supply Air and Exhaust Air Flow Diagram
SKM-12	Lubricating Oil and Compressed Air Flow Diagram
SKM-13	Sewage Treatment Plan
SKM-14	Sewage Treatment Flow Diagram
SKE-1	Site Electrical Distribution Plan
SKE-2	Electrical Substation Plan
SKE-3	Single Line Riser Diagram
SKE-4	Symbol List, Legend and Motor Control Centers

APPENDIX 1

START-UP MANUAL

FOR

TOTAL ENERGY PLANT

TABLE OF CONTENTS

One - Initial Start-Up Manual

TABLE OF CONTENTS (CONTINUED)

1. TEMPORARY SERVICE - FOR INITIAL START UP

1.1. General

1.1.1. The Engine Generators are to be used as the electric power source for plant test purposes.

1.1.2. Essential engine-generator systems are to be provided and tested as outlined below.

1.2. Electric Services

1.2.1. Provide portable source of electric power rated at 150 KW, 480 volts, 3 Ø, 4 wire, 0.8 PF, 60 HZ, complete with circuit breaker protection.

1.2.2. Provide a minimum of 600 gallons of diesel fuel oil per week for operating the portable power supply.

1.2.3. Check installation of Essential-Normal motor control center MCC-1B in order to permit the use of primary hot water pumps, raw water pumps, air compressor, essential exhaust fans and air cooled condensers.

1.2.3.1. Verify that all wiring is free from improper grounds and shorted and open circuits. Check continuity of all wiring and check insulation resistance between conductors, and between conductors and ground.

1.2.3.2. Check that all connections are made in accordance with the approved plans and specifications. Verify that all starters, fuses, thermal overload devices, matches the name plate rating of the equipment and that the voltage being supplied matches the equipment rating.

1.2.3.3. Make temporary connections to exhaust fans engine muffler exhaust and engine room exhaust in motor control center MCC-1A.

1.3. Compressed Air Systems

1.3.1. Clean and check the operation of the engine compressed air system in accordance with Section IIA, of Initial Cleaning.

Temporary Service (Continued)

1.4. Water Service

1.4.1. Connect to Local Water System and perform initial cleaning of primary hot water loop, and raw water loop in accordance with procedures outlined under Section IIE, of Initial Cleaning, Piping Systems.

1.4.2. Check operation of primary hot water and raw water system pumps and dry coolers in accordance with Section IV, of Motor and Pump Rotation.

1.4.3. Connect Local Water Supply System to primary hot water and raw water systems.

1.4.4. Fill systems and perform rough balance of the primary hot water and raw water system utilizing procedures outlined under Section VIA, of Balancing Circulating Water Systems.

1.5. Fuel Oil and Lube Oil Service

1.5.1. Provide temporary fuel oil and lube oil service to engine-generators to permit engine testing. Provide temporary pumps and oil storage.

1.5.2. Provide 500 gallons of diesel fuel oil per day per engine.

1.6. Exhaust System

1.6.1. Check out operation of exhaust fans engine muffler exhaust and engine room exhaust. Check electrical connections and operation in accordance with the procedures outlined under Section IVB, of Motor and Pump Rotation.

1.6.2. Test and perform rough adjustment of the exhaust systems in accordance with Section VIB, paragraph 4, of Balancing Air Systems.

1.7. Engine Testing

1.7.1. Individually test each engine-generator and the engine control system in accordance with the engine manufacturer and control system manufacturers' instruction manuals. Refer to Section VII, Testing-Engine-Generators for an outline of the procedures to be followed.

1.8. Water and Electric Service - Initial Plant Start Up

1.8.1. Make temporary electrical connections to engine-generator control system bus. Disconnect the portable source of electric power.

1.8.2. Make complete check of motor control centers in order to permit testing and cleaning of mechanical and electrical systems.

1.8.2.1. Carefully check all connections made against the approved plans verifying motor starter, size and fuse ratings. Verify that all wiring is free from improper grounds and shorted or open circuits. Check continually with an ohmmeter and megger test all wiring to check insulation resistance between conductors and conductor and ground.

1.8.2.2. Testing and operation of electrical equipment fed from these motor control centers is to be carried out during system testing as called for in the following sections of this Start-Up Manual.

1.8.3. Connect Local water supply to the condenser water and chilled water systems.

1.8.4. Bypass the domestic water system.

1.8.5. Carry out the initial cleaning and start-up procedures outlined in the following sections of this manual utilizing the engine-generators as the source of electric power.

2. INITIAL CLEANING

2.1. Compressed Air Systems

2.1.1. Clean waterpiping using procedure outlined under Initial Cleaning, Section IIE.

2.1.2. Check all the air compressors to verify that the electrical wiring and protective devices match the equipment electrical characteristics and is free from grounds, and shorted or open circuits. Check that the system components are securely installed.

2.1.3. Check that automatic draintrap connections are air tight and connected to floor drains.

2.1.4. Check compressor V belt drives for proper tension. Adjustment is made by moving the motor along the slide rails. For proper tension hand pressure should cause the belt to flex a distance equal to the overall belt thickness.

2.1.5. Check that the alternator connections between the two large compressors, are in accordance with the electrical wiring diagrams.

2.1.6. Verify that each receiver is properly leveled.

2.1.7. Compressor crankcase must be filled with oil suitable for industrial air compressor operation. Use SAE-30 weight and fill to full mark on oil level gauge. Oil level must always be maintained between the two marks on gauge. Check manufacturers operating and maintenance instructions for compressor oil capacity.

2.1.8. Check and lubricate electric motors in accordance with motor manufacturers.

2.1.9. Check Temperature Control Air Dryer Installation.

2.1.9.1. Check that air passes through in correct direction.

2.1.9.2. Blow all free moisture out of system.

2.1.9.3. Check that refrigerant gauge is reading at past 45 PSIG.

Initial Cleaning (Continued)

2.1.9.4. Check automatic expansion valve for correct setting between 23 to 36 PSIG. Adjust valve if necessary.

2.1.9.5. Check hot gas valve. Valve is pre-set at the factory. However, reduced air flow or low ambient temperature may make it necessary to adjust the operating controls to prevent frosting of refrigerant lines. Allow system to operate for 10 - 15 minutes to become balanced before any machine adjustment.

2.1.9.6. Air dryer must be started three to four minutes before the air compressor. Air dryers do not cycle on and off with the compressor.

2.1.10. Individually start compressors.

2.1.10.1. Check pressure gauge readings. Adjust oil pressure for approximately 15 lbs.

2.1.10.2. Measure voltage and amperage to verify proper system operation.

2.1.10.3. Check for proper cooling water flow. Throttle inlet water so that discharge water temperature is maintained at 130° to 160°F.

2.1.10.4. Using compressed air, blow out tanks and all air distribution system piping.

2.1.10.5. Test operation of alternator system.

2.1.10.6. Check that compressor is getting proper oil lubrication. Lubrication system should be run at minimum speed of four hundred (400) RPM.

2.1.10.7. Fill air tanks.

2.1.10.8. Verify that system is delivering specified rated air quantities and pressure.

2.1.11. Check other air compressor following procedures for the two layer units.

Initial Cleaning (Continued)

2.1.11.1. Non-reversible van type oil pumps must operate with counter-clockwise rotation. Verify type of pump supplied and check pump rotation.

2.2. Diesel Fuel Oil System

2.2.1. Initially clean fuel oil system piping using procedure outlined under Initial Cleaning, Section IIE. Dry piping by blowing out with compressed air. Fill piping system with fuel oil and flush to waste.

2.2.2. All electrically operated equipment should be checked for conformity with wiring diagrams and name plate data. Check that wiring is free from improper grounds and shorted or open circuits.

2.2.2.1. Float Alarm Units

2.2.2.1.1. Blow down the float chamber.

2.2.2.1.2. Check mercury switch for signs of damage.

2.2.3. Lubricate all motors and pumps prior to start-up.

2.2.4. Main storage tanks.

2.2.4.1. Allow fuel to stand for at least twenty (20) hours to allow water and sediment to settle to the bottom of the tank.

2.2.5. Day storage tanks should be checked for secure mounting.

2.2.6. Fill fuel oil system.

2.2.6.1. Prime fuel oil pumps.

2.2.6.1.1. Remove plugs from pump ports.

2.2.6.1.2. Pour generous amount of No. SAE-20 lubricating oil into suction port to provide start-up lubrication.

2.2.6.1.3. Re-install pump port plugs.

2.2.6.2. Start pump.

2.2.6.2.1. Check for correct motor rotation as indicated by directional arrow on unit.

2.2.6.2.2. Check pressure gauge and measure voltage and amperage to verify correct motor and pump operation.

2.2.6.3. Briefly test stand-by pump in same manner as lead pump.

2.2.6.4. Check operation of boiler diesel oil pump and stand-by pump in same manner as above.

2.2.6.5. Check oil flow through the boiler fuel oil systems.

2.2.6.6. Check oil flow through to engine generators.

2.2.7. Simulate malfunction problems to verify operation of sonic probe system and alarm system. Check automatic operation of stand-by pumps.

2.2.8. Clean all fuel oil system strainers and replace filter cartridges. Clean screens in vent valves.

2.3. <u>Lubricating Oil System</u>

2.3.1. Clean, test and fill system and check operation of lube oil pumps, using procedure outlined under Section IIB, Diesel Fuel Oil System.

2.4. <u>Boilers</u>

2.4.1. Inspect boilers and associated components for any physical damage due to shipping or installations.

2.4.2. Before initial firing of the boiler, a systems check should be made which shall include the following:

2.4.2.1. Verify that there is a sufficient supply of fuel on hand. A minimum of 6,000 gallons per week is required for each boiler.

2.4.2.2. Check all electrical connections to verify that they match electrical characteristics of the equipment.

2.4.2.3. Check for blown fuses, open circuit breakers and dropped out overload devices.

2.4.2.4. Measure operating voltage and amperage as a check on correct electrical operation of equipment.

Initial Cleaning (Continued)

2.4.2.5. Check resets on forced draft, fan motor starter and on the flame safeguard and programming control lockout switch. The number "0" should be showing in the combustion control window of the Timer Motor in the Flame Safeguard and Programming Control panel.

2.4.2.6. Check high limit temperature control setting. For boiler boil out procedure this should be set at 217 degrees.

2.4.2.7. Check operating limit temperature control setting. This should be set just above 212 degrees for boiling out the boiler.

2.4.2.8. Check modulating temperature control setting.

2.4.2.9. Inspect the low water cut off and pump control.

2.4.2.10. Check belt tensioning on air compressor.

2.4.2.11. One boiler should be completely valved off before boil out procedure is started.

2.4.2.12. Check boiler manufacturer's operation and service manual for any special test requirements applicable to this installation.

2.4.3. Boil boilers out in accordance with the procedure outlined below:

2.4.3.1. Fill with clean water until the top of the tubes are covered. The temperature of the initial fill water must not be less than 70 degrees.

2.4.3.2. Add soda ash and caustic soda in dissolved form to the water at a rate of three (3) to five (5) pounds of each chemical per one thousand (1,000) pounds of water. Then fill to the top with clean water. Weight of water flooded is 20,630 pounds.

2.4.3.3. Remove relief valves and temporarily connect relief valve openings with hoses to drain. All valves in piping leading to or from system must be closed to prevent cleaning solution from getting into system.

2.4.3.4. Fire boiler intermittently at a low rate sufficient to hold the solution just at the boiling point. During this slow firing, add a small amount of fresh water periodically to create an overflow that will carry off surface impurities.

2.4.3.5. Check water samples to be sure water is clear of grease and other impurities.

2.4.3.6. Boilers are to be re-cleaned, if necessary, until the water in the gauge glass is clear, boiler water line is steady, and no foaming occurs.

2.4.3.7. After the unit is properly cooled drain and flush completely with clean water using a high pressure water hose on internal water-side surfaces to flush out any deposits.

2.4.3.8. Re-install relief valves.

2.4.3.9. Refill boiler.

2.4.3.10. Set modulating temperature control just under 245 degrees.

2.5. Piping System

2.5.1. Inspect all systems for signs of damage and faulty connections.

2.5.2. All hot water, after-cooler water, condenser water, chilled water, water make-up, and oil piping systems are to be cleaned in order to remove pipe dope, oil, welding slag and other extraneous material in accordance with the procedure outlined below:

2.5.2.1. Provide temporary pump for initial circulation of water system being cleaned to protect system pumps. In the event a system pump must be used, provide two additional sets of seals and filters.

2.5.2.2. Check that all strainers, and filters are installed.

2.5.2.3. Fill system with trisodium phosphate solution at a rate of one(1) pound per fifty (50) gallons of water.

Initial Cleaning (Continued)

2.5.2.4. Fill, vent, and circulate the system allowing it to reach operating temperature of 200°F and circulate for a minimum of four (4) hours through the system.

2.5.2.5. Allow solution to cool and then drain system.

2.5.2.6. Fill system with clean cool water and flush system until waste water runs clear.

2.5.2.7. Clean all strainers, dirt pockets and flush out all drains. Inspect and replace cartridge filters if necessary. All strainers and filters are to be inspected and cleaned or replaced as necessary every four (4) hours during cleaning period.

2.6. <u>Heat Exchangers</u>

2.6.1. Inspect the units for signs of damage and faulty connection.

2.6.2. The heat exchangers are to be cleaned and flushed along with their associated piping systems. The procedure is outlined under Item 2.5. , Piping Systems.

2.6.3. If desirable, cleaning of heat exchangers can be accomplished separate from the complete system.

2.6.3.1. Install standpipes in the head openings.

2.6.3.2. Fill completely with trisodium phosphate solution at a rate of one(1) pound per fifty (50) gallons of water.

2.6.3.3. Allow to stand for four (4) hours.

2.6.3.4. Drain to waster and flush with fresh water.

2.6.3.5. Repeat procedure until flushing water runs clean.

2.7. <u>Cooling Towers</u>

2.7.1. Inspect cooling towers for signs of damage and incorrect installation. Check fan assemblies and motors, wet deck surface, strainer, float assemblies and eliminators.

2.7.2. Check that strainer screens are correctly installed. Clean screens.

Initial Cleaning (Continued)

2.7.3. Check that water distribution system is free of foreign materials.

2.7.4. Check, clean and flush the pan with clear water.

2.7.5. Check and clean the spray nozzles.

2.7.6. Check and clean air inlet screens.

2.7.7. Check that bleed water line is installed.

2.7.8. Check and clean the eliminators. Check installation to be sure blade installation and air orientation are in accordance with manufacturers specifications.

2.7.9. Cooling Tower start-up is covered under Scetion IIIB, Initial System Fill (Condenser Water System).

2.8. <u>Duct Systems</u>

2.8.1. Inspect duct systems to insure secure mechanical support, that all caulking is complete and all filters are in place.

2.8.1.1. All filters are to be cleaned and installed before operating the system.

2.8.2. Check fan and motor operation in accordance with procedures outlined in Section IVB, which covers motor and fan start-up.

2.8.3. Check damper inlet and outlet vanes for proper fit and freedom of operation.

2.8.4. Measure and record operating voltage and amperage of all motors.

2.8.5. Operate system for about twenty four (24) hours to blow construction dust out of duct work.

2.8.5.1. All dampers should be wide open.

2.8.5.2. Diffuser inner assemblies should be temporarily removed.

2.8.6. Install diffuser inner assemblies.

3 INITIAL SYSTEM FILL

3.1. Hot Water System

3.1.1. Check system components such as water meter, sample cooler, pumps, air release tanks, pot feeders and glycol tanks to see that all are securely installed.

3.1.2. Check installation and inter-connection of alarm devices with the temperature control panel.

3.1.3. Valves should be adjusted for normal operation as indicated on the flow diagram. On initial fill the pot feeders and glycol systems should be closed off from the system.

3.1.4. Close all air vents except vent at bottom of air control vent and begin filling the primary hot water pump section with water. Leave the air control vent open until water runs freely from it then close tightly.

3.1.5. Vent high points of the system.

3.1.6. Adjust pressure reducing valve to provide pressure to the highest point of the system.

3.1.7. Start primary hot water pumps one at a time.

3.1.7.1. Check out motor and pumps utilizing the procedure outlined in Section IVA, Motor and Pump Rotation.

3.1.7.2. Open gate valve in suction line to allow pump to fill with water.

3.1.7.3. Vent air from pump by unscrewing the top body plug from the shaft. Turn the shaft a few times by hand to allow all trapped air to escape. Replace the vent plug.

3.1.7.4. Start the pump with discharge valve closed.

3.1.7.5. Check for signs of leaks.

3.1.7.6. Gradually open discharge valve.

3.1.7.7. Adjust balancing valve for approximate design flow requirements.

3.1.7.8. Record pressure gauge, voltage and current readings.

3.1.7.9. Briefly check out operation of primary standby pump. Check control wiring.

Initial System Fill (Continued)

3.1.7.10. Disconnect pressure gauges from system.

3.1.8. Allow cold water to circulate for a short period of time to permit dislodgement of small air bubbles and return them to the release tank.

3.1.9. Stop pumps and fire one boiler. Stop firing when the boiler temperature reaches 220°F.

3.1.10 Wait at least one minute and then start pumps.

3.1.11 Stop pumps and vent system high points.

3.1.12 Dry cooler should be started to check out system operation.

3.1.12.1. All motors and fans should be checked in accordance with procedures outlined in Section IVB, Motor and Fan Rotation.

3.1.12.2. Sequence on the dry cooler fans and check temperature to verify this section of system is operating. Check voltage and amperage draw of each fan motor.

3.1.13 Check operation of emergency heat exchanger.

3.1.13.1. Make preliminary adjustment to plug valves.

3.1.13.2. Check return and supply temperatures.

3.1.14 Check operation of manual emergency valve.

3.1.15 Check out building heating, heat exchangers and hot water pump section.

3.1.15.1. Check the system components for proper installation.

3.1.15.2. Valves should be adjusted for normal operation as indicated on the flow diagram. On initial fill the chemical pot feeder should be closed off from the system.

3.1.15.3. Close all air vents except vent at bottom of air release tank fitting and begin filling the system with water. Leave the air control vent open until the water runs freely from it, then close tightly.

Initial System Fill (Continued)

3.1.15.4. Vent high points of the system.

3.1.15.5. Check out individually, the hot water pumps utilizing the procedures outlined in Section IVA, Motor and Pump Rotation.

3.1.15.6. The pumps are not self-priming and should be individually set up by the following procedure:

3.1.15.6.1. Fully open the gate valve in the suction line and close gate valve in discharge line.

3.1.15.6.2. Fill pump casing with liquid.

3.1.15.6.3. Open air vent to make sure air is forced from the pump.

3.1.15.6.4. Rotate shaft by hand to free entrapped air from impeller passageway.

3.1.15.6.5. Close air vent.

3.1.15.6.6. Start the pump motor and check pump and piping for pressure leaks.

3.1.15.6.7. When pump is operating at full speed, slowly open discharge gate valve until complete system flow is achieved.

3.1.15.6.8. Check discharge piping for pressure leaks and adjust balancing valve for approximately rated flow.

3.1.15.6.9. Record pressure reading, voltage and current.

3.1.16 Fill hot water system associated with the absorption generator operation.

3.1.16.1. Hot water pumps and standby pump should be checked out in accordance with the procedures outlined in Section IVA, Motor and Pump Rotation and primed in accordance with the procedure listed in Section III, Initial System Fill, Hot Water System, A15F.

Initial System Fill (Continued)

3.1.17 Test hot water system piping under a pressure of 125 PSIG for four (4) hours. Repair all leaks and retest.

3.1.18 Add initial charge of chemical treatment to establish an inhibitor level of one and one-half (1-1/2) times the normal level and allow to circulate in the system.

3.1.19 Read and record make-up water meter readings. Meter readings should be taken regularly to monitor system for possible leaks.

3.1.20 Disconnect all pressure gauges from the system.

3.2. Condenser Water System

3.2.1. Check system chemical feed tanks, pumps and control valves for proper installation. Check that piping to cooling towers is insulated and wrapped with the specified electric heating cables. Check cable operation by by-passing the thermostat.

3.2.2. Chemical feed system should be closed off from condenser water system.

3.2.3. Valves to absorption units and cooling towers should be closed. Discharge valves for cooling tower pumps should be closed.

3.2.4. Begin filling condenser water system.

3.2.5. Individually check operation of the cooling tower pumps, and standby pump in accordance with the procedure outlined in Section IVA, Motor and Pump Rotation.

3.2.5.1. Open gate valve in suction line to allow pump to fill with water.

3.2.5.2. Vent air from the pump by unscrewing the top body plug. Turn the shaft a few times by hand to allow all trapped air to escape. Replace the vent plug.

3.2.5.3. Start the pump with the discharge valve closed.

3.2.5.4. Check for signs of leaks.

3.2.5.5. Gradually open discharge valve.

3.2.5.6. Adjust balancing valve for approximately the design flow requirements.

Initial System Fill (Continued)

3.2.5.7. Record pressure gauge, voltage and current readings.

3.2.5.8. Repeat procedure 5a -5g to check out cooling former pump and standby pump.

3.2.6. Check out cooling tower electrical systems:

3.2.6.1. Check motor and fan shaft alignment and make preliminary fan belt adjustment following procedures outlined in Section IVB, Motor and Fan System.

3.2.6.2. Check bearing locking collars.

3.2.6.3. Motor and fans are to be lubricated before starting using waterproof lithium base, inhibited greases which are good for a temperature range of 65°F to 250°F (Shell Oil - Aerogrease 7A or equal). When greasing fan shaft bearings, purge bearing gradually until new grease appears at grease seals.

3.2.6.4. Check voltage and amperage draw as a check on normal operation.

3.2.6.5. After 16 hours of operation adjust fan belt for proper tension, hand pressure should cause the belt to flex a distance equal to the overall belt thickness.

3.2.7. Start cooling tower water fill.

3.2.7.1. Check pan water operating level. The float make-up valve is factory pre-set for start-up. The normal operating level should be 4 to 5 inches below the center line of the overflow pipe. The float valve should be completely shut off when the water level in the pan is 1/2" below the overflow pipe centerline.

3.2.7.2. Check that water bleed system is operating.

3.2.8. Check out cool water make up.

3.2.9. Test condenser water system piping under a pressure of 125 PSIG for four (4) hours. Repair all leaks and retest.

Initial System Fill (Continued)

3.2.10 Add initial charge of chemical treatment to establish an inhibitor level of one and one-half (1-1/2) times the normal level and allow to circulate in the system. Rate of charge to be as recommended by water treatment equipment supplier.

3.2.11 Disconnect all pressure gauges from the system.

3.3 Chilled Water System

3.3.1. Check system components for correct and secure installation. Chemical pot feeder, valves and valves to absorption units, and chilled water pump discharge valves should be closed. All other valves should be set for normal operation.

3.3.2. Close all air vents except vent at bottom of air control unit and begin filling system.

3.3.3. Close air control vent after water runs freely from it.

3.3.4. Vent high points of system.

3.3.5. Adjust pressure reducing valve to provide pressure to the highest point of the system.

3.3.6. Check individually the operation of the chilled water pumps, utilizing the procedures outlined in Section IVA, Motor and pump rotation.

3.3.6.1. Close discharge valve and fill pump.

3.3.6.2. Vent air from the pump body by unscrewing the top body plug. Turn the shaft by hand a few times to allow all trapped air to escape. Replace the vent plug.

3.3.6.3. Start the pump with the discharge valve closed.

3.3.6.4. Slowly open discharge valve and check piping for signs of leaks.

3.3.6.5. Briefly test standby pump, following procedure used for the chilled water pump.

3.3.6.6. Record pump pressure, voltage and current for both pumps.

3.3.7. Test chilled water system under a pressure of 125 PSIG for four (4) hours. Repair all leaks and retest.

Initial System Fill (Continued)

3.3.8. Add initial charge of chemical treatment to establish an inhibitor level of one and one-half (1-1/2) times the normal level and allow to circulate in the system. Rate of charge to be as recommended by water treatment equipment supplier.

3.3.9. Disconnect all pressure gauges from the system.

3.4. Raw Water System

3.4.1. Check system chemical feed tanks, glycol fill tank, pumps, air separator, and control valves for proper installation.

3.4.2. Chemical pit feeder and glycol fill tank should be closed off from the system.

3.4.3. Adjust air release tank system following procedure outlined in the section on chilled water system, IIIC, 2 - 5.

3.4.4. Individually check raw water pumps and standby pump.

3.4.4.1. Utilize the procedure outlined in Section IVA, Motor and Pump Rotation.

3.4.4.2. The pumps are not self priming and should be started using the procedure outlined in Section III, 15f, Initial System Fill.

3.4.5. Check each pump individually, recording pump pressure, voltage and amperage.

3.4.6. Check operation of dry cooler.

3.4.6.1. Prior to start up, all fans should be checked mechanically and electrically and fan belts adjusted in accordance with the procedure outlined in Section IVB, Motor and Fan Rotation.

3.4.6.2. Check operating performance by sequencing on the fans. Check temperatures and motor voltage and amperage as check on system operation.

3.4.7. Check operation of reheat oil system in the TUS plant.

3.4.7.1. Fill system.

3.4.7.2. Check out operation of reheat oil pump.

Initial System Fill (Continued)

3.4.7.2.1. Utilize procedure outlined in Section IVA, Motor and Pump Rotation.

3.4.7.2.2. Since pump is not self priming use procedure outlined in Section III, 15F (Initial System Fill) to start pump.

3.4.7.3. Make preliminary system adjustments, record pump pressure, and voltage and amperage draw.

3.4.8. Test raw water system piping under a pressure of 125 PSIG for four (4) hours. Repair all leaks and retest.

3.4.9. Add initial charge of chemical treatment to establish an inhibitor level of one and one-half (1-1/2) times the normal level and allow to circulate in the system. Rate of charge to be as recommended by water treatment equipment supplier.

3.4.10 Disconnect all pressure gauges from the system.

3.5. <u>Absorption Generator - Start-Up</u>

3.5.1. Associated System Requirements.

3.5.1.1. Chilled water system completely tested and operational.

3.5.1.2. Condenser cooling water system and cooling tower completely tested and operational.

3.5.1.3. Hot water system completely tested and operational.

3.5.1.4. All electric and pneumatic controls installed and tested in accordance with control diagrams.

3.5.1.5. All required gauges and thermometers should be installed.

3.5.1.6. Sufficient load must be available for test purposes.

3.5.1.7. Clean all cooling water and chilled water strainers.

3.5.1.8. Fill cooling and chilled water systems and circulate water for one or two days to vent air from the system.

Initial System Fill (Continued)

3.5.1.9. Check operation of the cage type float switch. Water level in pan should be 4 to 5" below center of the overflow pipe.

3.5.2. Absorption Generator Pre-Start Requirements

3.5.2.1. Initial lithium bromide and octyl alcohol charge are to be done under the direct supervision of the manufacturer's service representative.

3.5.2.2. Operational start-up is to be in accordance with the Manufacturer's recommendation.

3.5.2.3. All systems sequence of operation and temperature control operations must be checked out.

4. MOTOR AND PUMP ROTATION

4.1 General Procedures Applicable to Motor and Pump Systems:

4.1.1 Inspect equipment for signs of damage.

4.1.2 Check alignment with a straight edge of all drive driven sheaves. The top, bottom and side alignment should be checked. Flexible couplings where used do not compensate for misalignment.

4.1.3 Rotate shifts by hand to be sure they rotate freely.

4.1.4 Check electrical wiring diagrams and nameplate data to insure correct connections. Starting and overload devices if used should match electrical characteristics of the motor.

4.1.5 The motor and pump bearings must be lubricated with grease and with No. 2 mineral base of lithium base petroleum grease.

4.1.6 Tighten plugs in gauge and drain taps. If pump is fitted with pressure gauges, keep gauge cocks closed when not in use.

4.1.7 Check that suction and discharge piping are independently supported by pipe hangers or other supports near the pump and are porperly aligned so that no strain is transmitted to the pump when the flange bolts are tightened.

4.1.8 Check all flange bolts to be sure they are securely tightened.

4.1.9 Check rotation by briefly supplying power to the motor. Motor shaft must rotate in direction indicated by arrow cast in pump body. Be sure that the rotation is correct for direction of flow desired. Measure voltage and current to be sure it matches nameplate data requirements.

4.2 General Procedures Applicable to Motor and Fan Systems.

4.2.1 The procedures outlined under Sections 4.1.1 to 4.1.4 are generally applicable to motor operated fan systems and are to be carried out.

4.2.2 Fans:

4.2.2.1 Manually check for free rotation.

Motor and Pump Rotation (Continued)

4.2.2.2 Check that fan wheel is centered in housing.

4.2.2.3 Check that all bolts and nuts are tight.

4.2.2.4 Check horizontal and vertical bearing alignment.

4.2.2.5 Bearing and fan wheel set screws should be tight.

4.2.2.6 Check alignment of pulleys and belts. For proper alignment, using a straight edge, points of contact must be made with the outer faces of both pulleys.

4.2.2.7 Belt drives are not factory adjusted. The belts should be tensioned until pressing against the belt midway between pulleys, will deflect the belt about one-half (1/2) inch with moderate pressure.

4.2.2.8 Lubricate fan and motor.

4.2.2.9 Check for correct rotation and any excess vibration by briefly applying power to the unit.

4.2.2.9.1 Presence of excess vibration will require that the fan wheel be rebalanced.

5. DRAINING AND RECLEANING

5.1 Air Systems

5.1.1 Check finned intercoolers for dust deposits. Blow clean with compressed air.

5.1.2 Check V belt drive for correct tension.

5.1.3 Clean air intake filters and line strainers.

5.1.4 Manually open drain cocks on dryers under pressure to clean out collected sediment.

5.1.5 Start compressors and check motors for rated voltage and amperage.

5.1.6 Check gauge readings to verify that rated air pressure and air quantities are being delivered.

5.2 Oil Systems

5.2.1 Diesel Fuel Oil System

5.2.1.1 Clean all strainers.

5.2.1.2 Replace all throw away filters.

5.2.1.3 Drain day tanks.

5.2.1.3.1 Blow out all lines with compressed air to make sure they are clean.

5.2.1.3.2 Flush tank with hot water under pressure to loosen and remove scale or sediment.

5.2.1.3.4 Use compressed air to dry out tank.

5.2.2 Lubricating oil system

5.2.2.1 Clean system following procedures outlined in Section 5.2.1.

5.3 Boilers

5.3.1 Drain the pressure vessel, remove the handhole and manhole covers and inspect the internal waterside surfaces for signs of corrosion, pitting or formation of deposits.

Draining and Recleaning (Continued)

5.3.2 Flush out the interior with water using high pressure hose. If deposits are not completely removed check with feedwater treatment company for proper procedure.

5.3.3 Check water meter readings to determine if there are system water leaks.

5.4 Piping Systems

5.4.1 All hot water, after cooler water condenser water, chilled water, water makeup piping systems are to be drained and cleaned as outlined below:

5.4.1.1 Drain system. Clean all strainers, dirt pockets and flush out all drains.

5.4.1.2 Clean piping system using procedure outlined in Sections 2.5.2.3 through 2.5.2.7, Initial Cleaning, Cleaning of the Heat Exchangers.

5.4.1.3 Pressure gauges should be disconnected from the system during cleaning procedures and then reconnected.

5.5 Cooling Towers

5.5.1 Check fan and motor bearings and lubricate if necessary, check tightness, and adjustment of locking collars.

5.5.2 Check belt adjustment.

5.5.3 Clean strainer.

5.5.4 Clean and flush pan.

5.5.5 Check fan and air inlet screens and remove any dirt or debris.

5.5.6 Check bleed water valve to insure it is not clogged with dirt.

5.6 Duct Systems

5.6.1 Check, vacuum clean, and re-install all filters.

6. BALANCING

6.1 Circulating Water Systems

6.1.1 General

6.1.1.1 The systems shall be completely installed and in continuous operation as required to accomplish the test, adjust and balance work specified.

6.1.1.2 List all mechanical specifications of tested equipment and verify against latest approved plans and specifications.

6.1.1.3 Open all line valves to full open position.

6.1.1.4 For each pump test and record pump shut-off head and pump wide-open head. Compare with manufacturer's pump curve. Plot new curve if there are significant differences.

6.1.1.5 Verify proper water level in expansion tanks and in the system.

6.1.1.6 Verify that air vents in high points of water systesms are operating freely.

6.1.2 Hot Water System

6.1.2.1 Verify that all valves are set for normal operation.

6.1.2.2 Verify that the correct water level is maintained in the boilers. Operate boilers initially at low rate and adjust for load changes until maximum load demand is met.

6.1.2.3 Adjust rate of flow of the primary hot water pumps to approximately 15% above design conditions. Record pressure gauge readings. Pumps should be operating air-free and without cavitation. If unreliable readings, as a reference check on the pump operating point. Use a watt meter to determine wattage draw. Use wattage, pump efficiency and pump curves to determine pump brake horsepower and operating point.

6.1.2.4 Verify that water flow through the boilers is equal to or better than the design minimum.

Balance (Continued)

6.1.2.5 Adjust flow of water through boilers to design rate.

6.1.2.6 Adjust boiler to design operating temperatures.

6.1.2.7 Observe entering and leaving boiler water temperature.

6.1.2.8 Check rate of flow through heat exchangers and entering and leaving temperatures against specified design conditions.

6.1.2.9 Verify water flow through engine system and check against specified design conditions.

6.1.2.10 Make all necessary re-adjustments to primary hot pumps to achieve specified flow and temperature conditions through the heat exchangers and engines. Record entering and leaving water temperatures.

6.1.2.11 Record pump operating suction and discharge pressures and final dynamic head. Record rated electrical amperage and actual running amperage for each pump motor.

6.1.2.12 Verify correct operation of standby primary hot water pump. System should be in balance when any two of the primary pumps are in use.

6.1.2.13 Adjust flow rate of secondary hot water pumps to approximately 15% above design conditions. Record pressure gauge readings. Pumps should be operating air-free and without cavitation.

6.1.2.14 Check flow through absorber. Check inlet and outlet temperatures and rate of flow.

6.1.2.15 Adjust flow as required to achieve specified design conditions. Re-adjust secondary pump operation as required. Record entering and leaving water temperatures.

6.1.2.16 Verify correct operation of standby secondary hot water pump. System should be in balance when any two of the secondary pumps are in use.

6.1.2.17 Check entire primary hot water system for any changes in operating conditions.

6.1.2.18 Re-adjust primary and secondary systems as required to obtain conditions called for in the specifications.

6.1.2.19 Record pump operating suction and discharge pressures, and final dynamic head. Record rated electrical amperage and actual running amperage for each pump motor.

6.1.3 Condenser Water System

6.1.3.1 Set valves for normal system operation.

6.1.3.2 Adjust rate of flow of the cooling tower pumps to approximately 15% above design conditions. Record pressure gauge readings. Pumps should be operating air-free and without cavitation.

6.1.3.3 Observe and measure flow through cooling tower.

6.1.3.4 Check absorber condenser circuit for inlet and outlet temperatures and water flow rate.

6.1.3.5 Make all necessary re-adjustments to cooling tower pumps to achieve specified conditions through condenser.

6.1.3.6 Verify correct operation of standby cooling tower pump. System should be in balance when any two of the cooling tower pumps are in use.

6.1.3.7 Record condenser inlet and outlet temperature and rate of flow.

6.1.3.8 Record pump operating suction and discharge pressures and final dynamic head. Record rated electrical amperage and actual running amperage for each pump motor.

6.1.4 Chilled Water System

6.1.4.1 Verify status of chilled water distribution piping. If system not complete, set up temporarily closed loop system.

6.1.4.2 Adjust rate of flow of chilled water pump to approximately 15% above design conditions. Record pressure gauge readings. Pumps should be operating air-free and without cavitation.

6.1.4.3 Determine water flow rate through absorbers.

6.1.4.4 Make all necessary re-adjustments to the chilled water pump to achieve specified conditions through the absorbers.

6.1.4.5 Verify correct operation of system when utilizing the standby chilled water pump.

6.1.4.6 Record absorber inlet and outlet chilled water temperatures.

6.1.4.7 Record pump operating suction and discharge pressures and final dynamic head. Record rated electrical amperage and actual running amperage for each pump motor.

6.1.5 Raw Water System

6.1.5.1 Set valves for normal system operation.

6.1.5.2 Adjust rate of flow of raw water pumps to approximately 15% above design conditions. Pumps should be operating air-free and without cavitation.

6.1.5.3 Determine rate of flow through engine oil and after cooler system.

6.1.5.4 Determine rate of flow through Dry Cooler.

6.1.5.5 Determine rate of flow through heat exchangers. Measure inlet and outlet water temperatures.

6.1.5.6 Make all necessary re-adjustments to the raw water pumps to achieve specified flow and temperature conditions through the heat exchangers and the engines. Record entering and leaving water temperatures.

6.1.5.7 Verify correct operation of standby raw water pump. System should be in balance when any two of the raw water pumps are in use.

6.1.5.8 Adjust rate of flow of pump to approximately 15% above design conditions.

6.1.5.9 Balance flow of water to the heating coil and reheat coils to design specifications. Re-adjust pump as required.

6.1.5.10 Record entering and leaving water temperatures.

6.1.5.11 Check main raw water loop for any changes in operating conditions.

6.1.5.12 Re-adjust entire system as required to obtain specified conditions.

6.1.5.13 Record pump operating suction and discharge pressures and final dynamic head. Record rated electrical amperage and actual running amperage for each pump motor.

6.2 Air Systems

6.2.1 General

6.2.1.1 The systems shall be completely installed and in continuous operation as required to accomplish the test, adjustment and balance work specified.

6.2.1.2 The work shall be performed when outside conditions approximate design conditions specified for heating and cooling functions.

6.2.1.3 Make a list of all equipment to be tested including manufacturer's name, type, and size of unit and rating.

6.2.1.4 Set all main duct and branch duct dampers of supply and exhaust systems to maximum position.

6.2.1.5 Set all diffuser and return outlet dampers for maximum volume.

6.2.1.6 Clean all fitters as required.

6.2.1.7 Close all outside doors and windows.

6.2.1.8 Secure outside air dampers and recirculating damper at minimum outside air settings.

Balancing (Continued)

6.2.1.9 Start all fans.

6.2.1.10 Take tachometer readings of all fans and set fan speeds to design RPM.

6.2.1.11 Check and record all motor name plate data, starter heater ratings and actual running amperage and voltage. Check motor and fan in accordance with Section 4.2, motor and fan rotation.

6.2.2 <u>Supply System - Engine Generator and Boiler Room</u>

6.2.2.1 Test and adjust as required fan RPM to design conditions.

6.2.2.2 Measure delivered CFM at branch duct outlet farthest from the fan. Calculate ratio of delivered CFM to design CFM.

6.2.2.3 Measure delivered CFM and calculate ratio of delivered CFM to design CFM for the next outlet in the duct branch. Adjust outlet damper to get approximately the same delivered to design CFM ratio as obtained at the farthest outlet.

6.2.2.4 In like manner adjust each succeeding outlet in the branch duct to get approximate balance based on the ratio of delivered to design CFM.

6.2.2.5 Repeat above procedure for each branch.

6.2.2.6 Balance branches with one another by first selecting one outlet in the first branch to balance with an outlet in the second branch. Balance the outlets based on the ratio of delivered to design CFM. In like manner continue until the entire system is proportionally balanced.

6.2.2.7 Record preliminary CFM at each outlet during initial proportional balancing.

6.2.2.8 Measure total delivered CFM at fan and adjust as required to obtain total design CFM.

6.2.2.9 Make final adjustment on all outlets to obtain design conditions.

Balancing (Continued)

6.2.2.10 Record supply fan and outlet CFM.

6.2.2.11 Record final supply fan running amperage and voltage.

6.2.3 Supply System - Oil Pump Room

6.2.3.1 Test and adjust supply fan to meet design requirements for CFM. Record data as called for in preceding section.

6.2.4 Exhaust System

6.2.4.1 Test and adjust each exhaust fan.

6.2.4.2 Measure CFM and if not within 10% of design requirements, adjust fan speed accordingly.

6.2.4.3 Measure air velocity at each return and adjust as necessary to obtain design air volume.

6.2.4.4 Check exhaust fan total CFM and adjust for design requirements.

6.2.4.5 Make final adjustment of exhaust returns.

6.2.4.6 Record motor name plate data, fan RPM and

7. TESTING - ENGINE-GENERATOR

7.1 Engine-Generator

7.1.1 The engine-generators should be checked for correct electrical and mechanical installation. Check all wiring against the latest approved wiring diagrams. Check point to point continuity using ohmmeter. Individually check and test engine-generator in accordance with the following procedures:

7.1.1.1 Make pre-start check on each unit in accordance with the instructions outlined in the engine manufacturer's operation guide manual.

7.1.1.2 Connect 3 phase load bank system to engine-generator for manual test purposes.

7.1.1.3 Connect to the engine-generator the portable engine test control box furnished by control manufacturer. Operating instructions should be furnished with the test unit.

7.1.1.4 Check that all control wiring is correctly installed using procedures outlined in the control manufacturer's installation and service manual.

7.1.1.5 Perform engine operation adjustments outlined in the manufacturer's operation guide manual.

7.1.1.6 Perform engine operation check called for in the control manufacturer's installation and service manual. Utilize the test control box furnished by them.

7.1.1.7 It is essential that all units are set up to have the same phase rotation, same speed capabilities and same voltage characteristics.

7.2 Engine Control System

7.2.1 Completely check installation of the control system in accordance with the procedures outlined for installation in the control manufacturer's installation and service manual.

7.2.2 Study the installation and service manual to become thoroughly familiar with operating procedures in order to effectively utilize the system.

7.2.3 Phase rotation is extremely important. Correct phase connections are marked on the back of each control system circuit breaker. Use phase rotation meter and check in accordance with installation and service manual procedures.

7.2.4 All engine-generators must be tested in manual mode before testing automatic control system.

7.2.4.1 Use load banks for initial test purposes. Provide a balanced load not to exceed name plate rating of unit.

7.2.4.2 Separately check and test each engine-generator in accordance with the test procedures outlined in the installation and control system manual, installation check out.

7.2.4.3 Manually check and test combined operation of engine-generators in accordance with the procedures outlined in the control system manual, manual paralleling.

7.2.4.4 Refer to the Specifications for Engine-Generators of Total Energy Plant, Field Testing and STarting. All instructions and tests called for should be carried out.

7.2.4.5 Complete all manual system tests called for in the installation and control system manual.

7.3 Lubrication and Maintenance

7.3.1 Carry out all required lubrication and maintenance called for in the manufacturer's operation guide manual. Check all gauges and meters in accordance with manufacturer's recommendations.

7.4 Total System Testing

7.4.1 Set control system for fully automatic operation.

7.4.2 Use the three phase banks for test purposes.

Testing - Engine-Generators (Continued)

7.4.3 Conduct tests of systems following procedures outlined in the control manufacturer's installation and service manual.

7.4.4 Keep the electrical load balanced. Check that the current flow per phase does not exceed the name plate rating.

8. TESTING-POWER DISTRIBUTION

8.1 TUS Building

8.1.1 Check all circuits and electrical equipment for grounds, shorted or open circuits, and proper functioning. All temporary connections should be replaced with final permanent connections.

8.1.2 Make insulation resistance tests on all feeder cable as well as all motor leads and control wiring. Make tests between conductors and between conductor and ground.

8.1.3 Interconnect building bus system and engine-generator control system.

8.1.4 Carefully check interlocking, control, and instrumentation wiring for each system and/or part of system to ascertain that the system will function properly as indicated by schematic and wiring diagrams.

8.1.5 Measure panel loads for balanced conditions. Make changes required to provide load balance.

8.2 Site Electrical System

8.2.1 Assist Site Contractor in checking electrical system.

8.2.2 Check all circuits and electrical equipment for grounds, shorted or open circuits and proper functioning. Check is to include wiring from public utility transformer vault, the emergency switchboard, and all distribution feeders.

8.2.3 Make insulation resistance tests on all feeder cable as well as all motor leads and control wiring. Make tests between conductors and between conductor and ground.

8.2.4 Carefully check interlocking, control, and instrumentation wiring for each system and/or part of system to ascertain that the system will function properly as indicated by schematic and wiring diagrams.

8.2.5 Check rotation of all motors.

9. PLANT START-UP

9.1 Water Systems

9.1.1 Check water system for signs of leaks. Check that all water treatment facilities are in operation. Record all water meter readings in log book.

9.2 Engine Start-Up

9.2.1 Perform required periodic maintenance on engines. Make walk-around check of the installation. Make pre-start checks called for in manufacturer's operation guide manual.

9.2.2 Refer to operating instructions of the control manufacturer's installation, and service manual. Start system in normal mode of operations.

9.2.3 Immediately start equipment connected to essential system motor center.

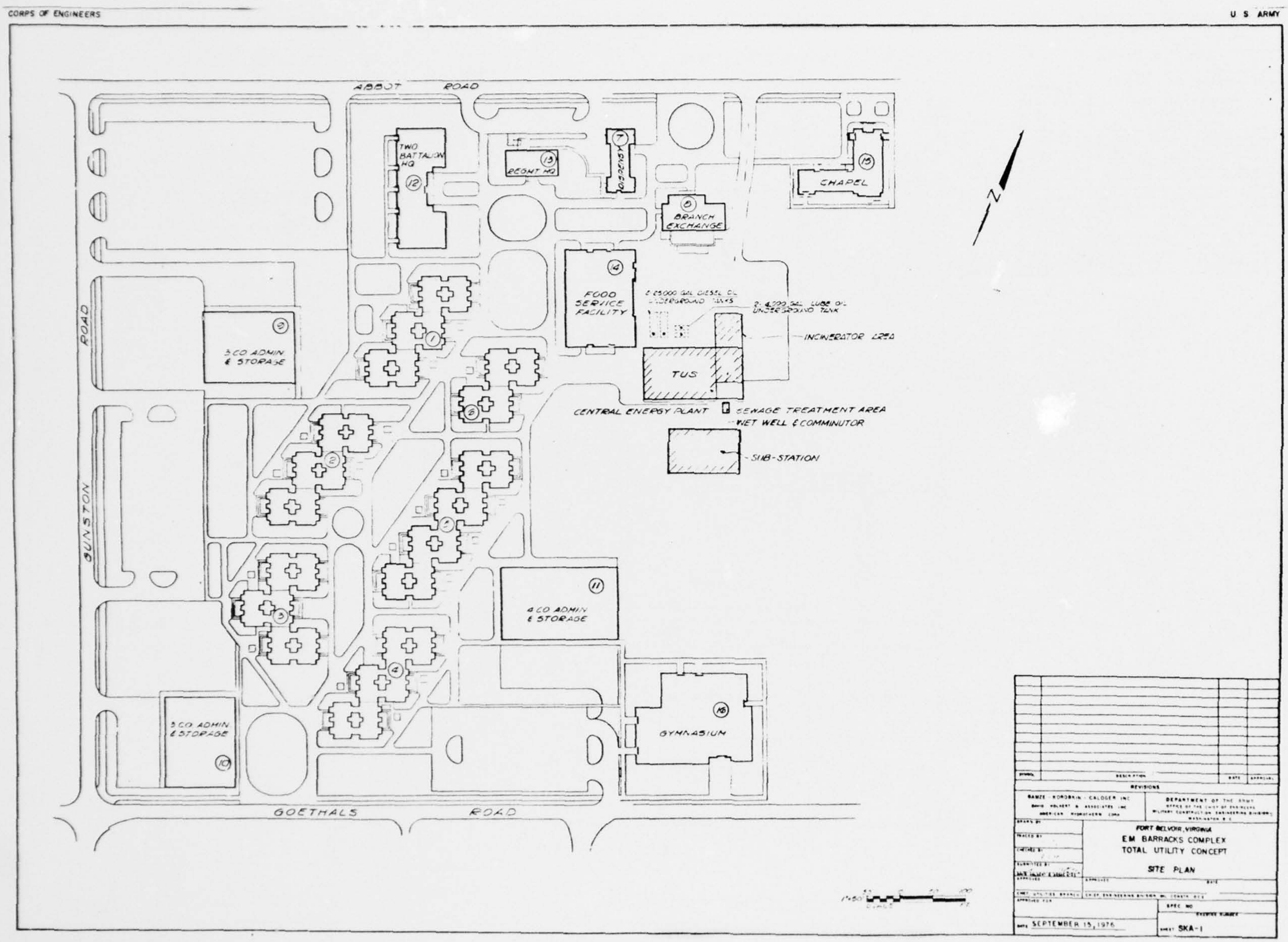
9.2.4 With system operating normally, start adding TUS Building load onto the system.

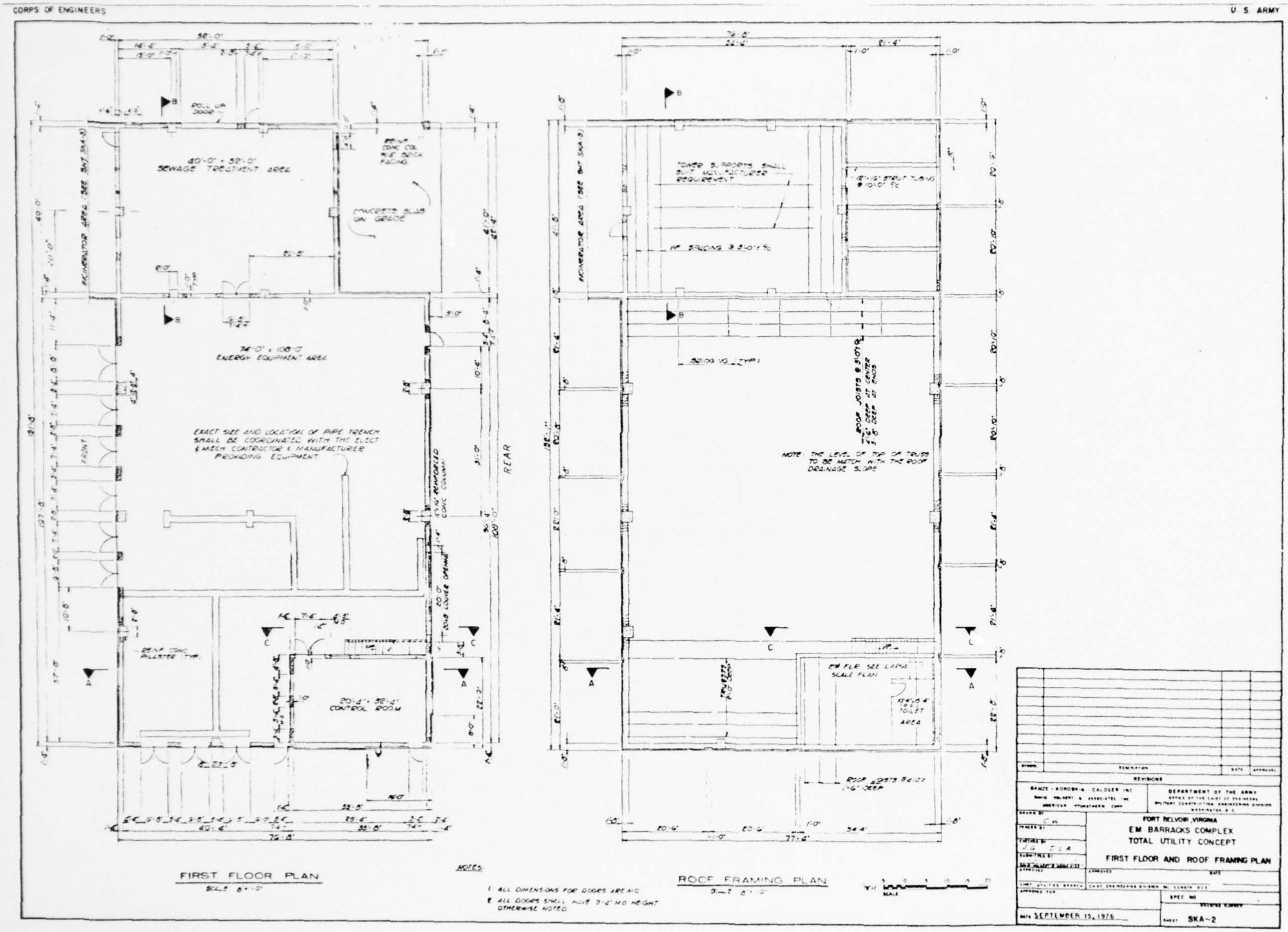
9.2.5 Energize site electrical distribution system.

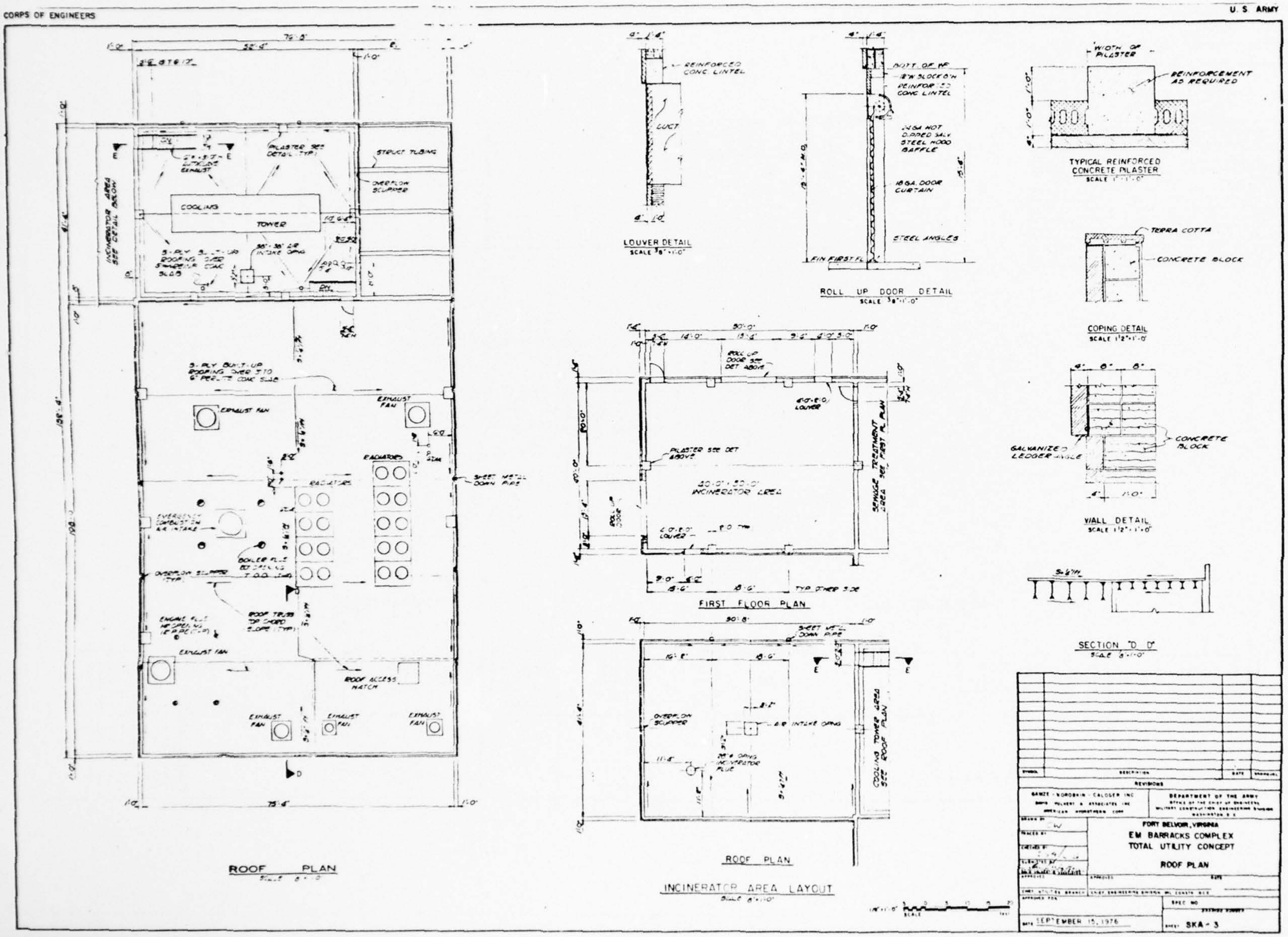
9.2.6 Adjust Time Reference Control. Refer to installation and service manual for method.

9.3 Operating Procedure

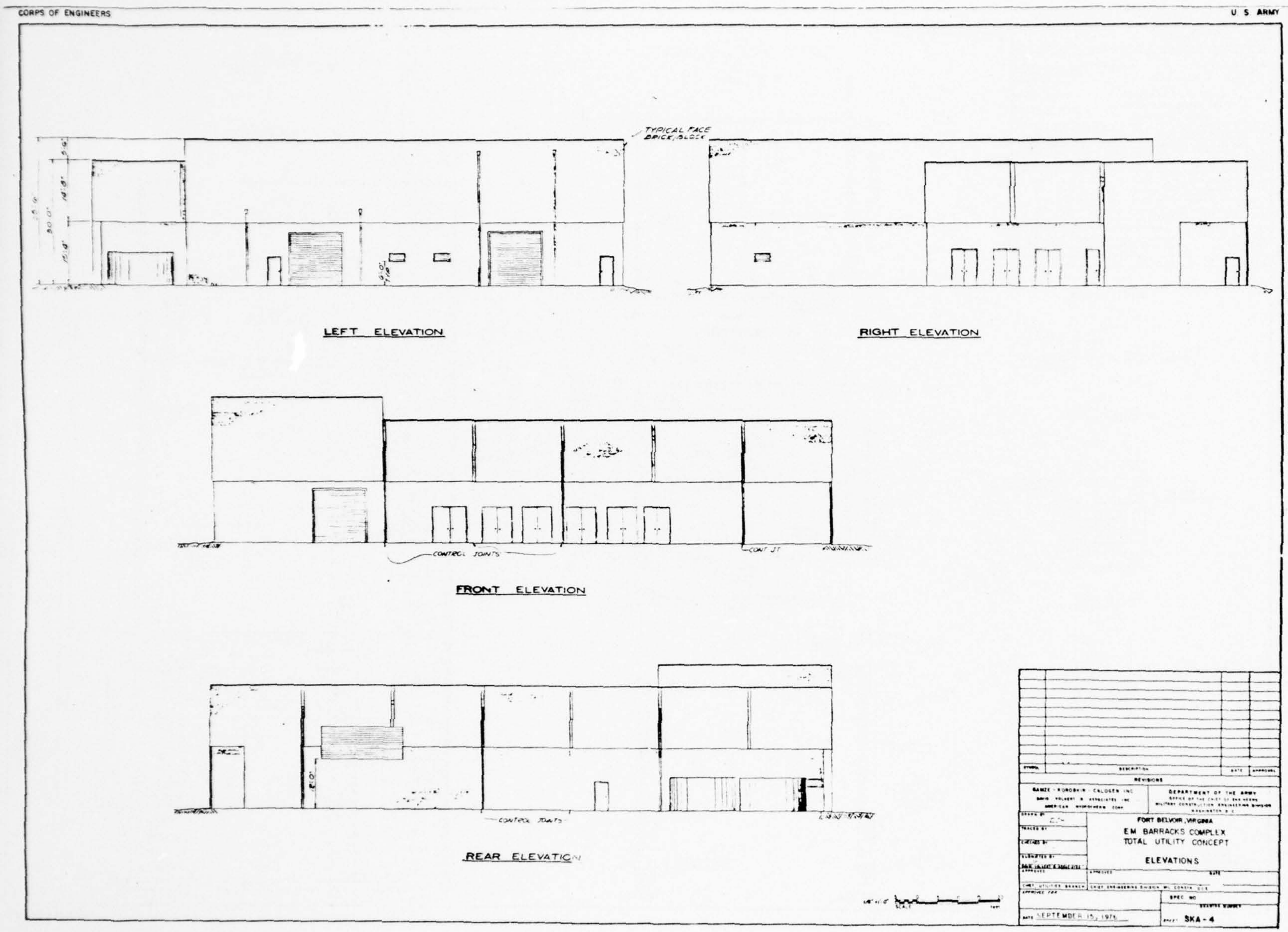
9.3.1 Commence normal operating and maintenance procedures as called for in the operating and maintenance manuals.

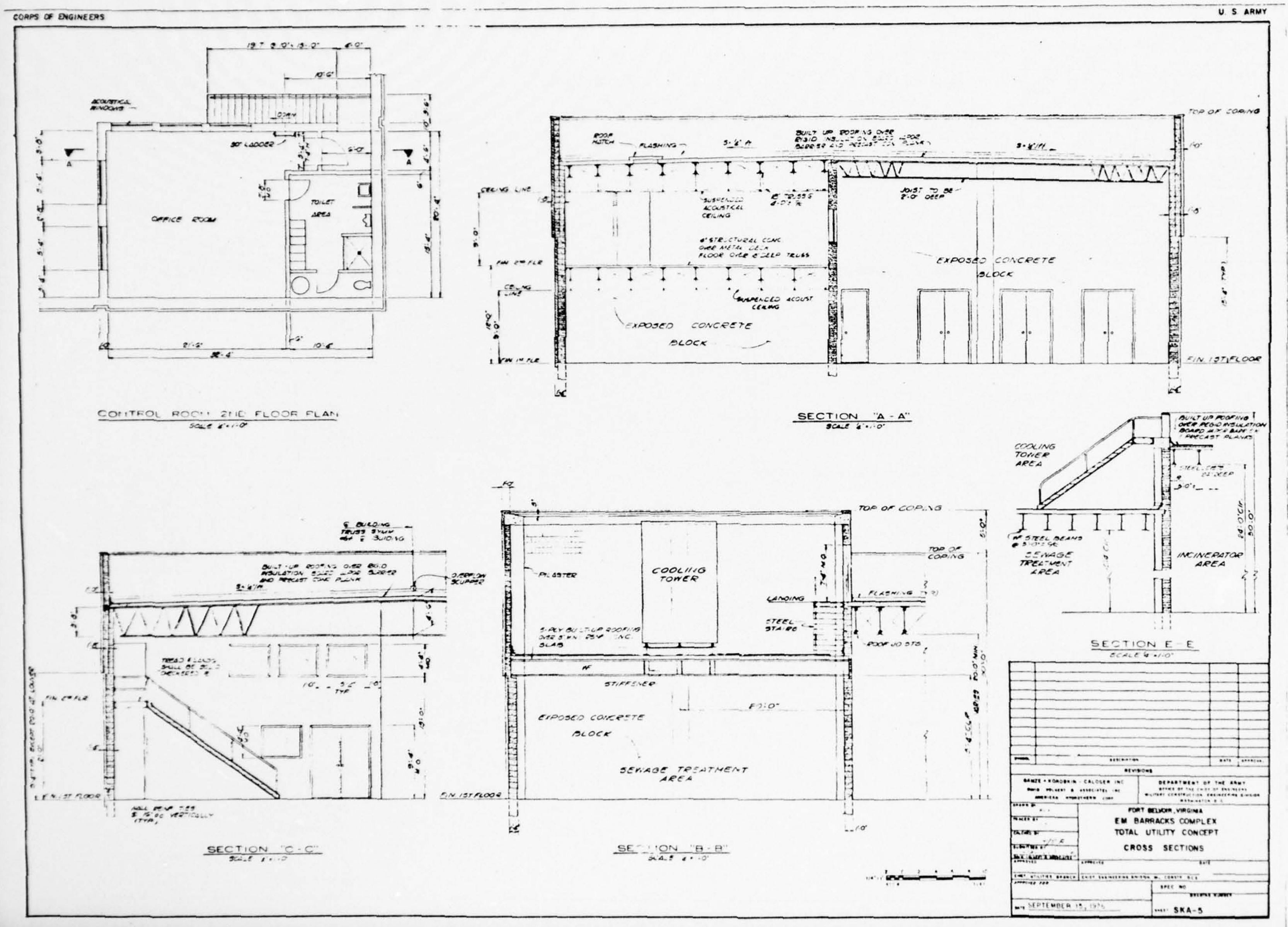

CORPS OF ENGINEERS
U S ARMY
ABBOT ROAD
GUNSTON ROAD
GOETHALS ROAD
TWO BATTALION HQ
12
REGMT HQ
13
CHAPEL
15
BRANCH EXCHANGE
FOOD SERVICE FACILITY
14
3 CO ADMIN & STORAGE
9
4 CO ADMIN & STORAGE
11
3 CO ADMIN & STORAGE
10
GYMNASIUM
16
2-25000 GAL DIESEL OIL UNDERGROUND TANKS
2-4000 GAL LUBE OIL UNDERGROUND TANK
INCINERATOR AREA
TUS
CENTRAL ENERGY PLANT
SEWAGE TREATMENT AREA
WET WELL & COMMINUTOR
SUB-STATION
N
1
2
3
4
5
6
7
REVISIONS
RAMZE · KORDBAIN · CALOGER INC
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SITE PLAN
SEPTEMBER 15, 1976
SKA-1

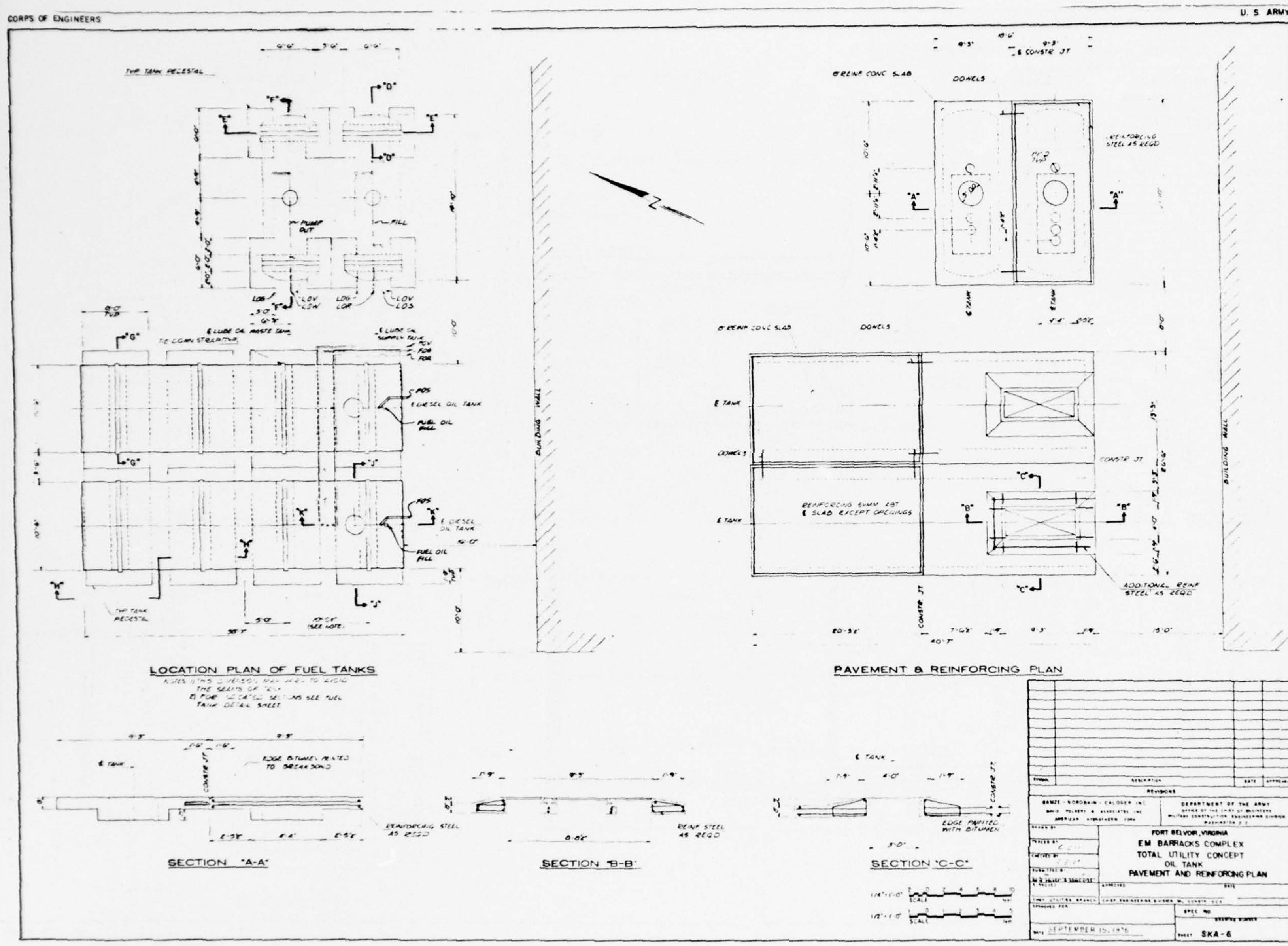

CORPS OF ENGINEERS
U S ARMY
40'-0" x 32'-0"
SEWAGE TREATMENT AREA
CONCRETE SLAB ON GRADE
ROLL UP DOOR
74'-0" x 108'-0"
ENERGY EQUIPMENT AREA
EXACT SIZE AND LOCATION OF PIPE TRENCH SHALL BE COORDINATED WITH THE ELECT & MECH. CONTRACTOR & MANUFACTURER PROVIDING EQUIPMENT
FRONT
REAR
REINF. CONC. PILASTER (TYP.)
20'-6" x 32'-4"
CONTROL ROOM
FIRST FLOOR PLAN
NOTES:
1. ALL DIMENSIONS FOR DOORS ARE N.O.
2. ALL DOORS SHALL HAVE 8'-0" M.O. HEIGHT OTHERWISE NOTED
TOWER SUPPORTS SHALL SUIT MANUFACTURER REQUIREMENT
NOTE: THE LEVEL OF TOP OF TRUSS TO BE MATCH WITH THE ROOF DRAINAGE SLOPE
ROOF FRAMING PLAN
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
FIRST FLOOR AND ROOF FRAMING PLAN
DEPARTMENT OF THE ARMY
REVISIONS
SEPTEMBER 15, 1976
SKA-2

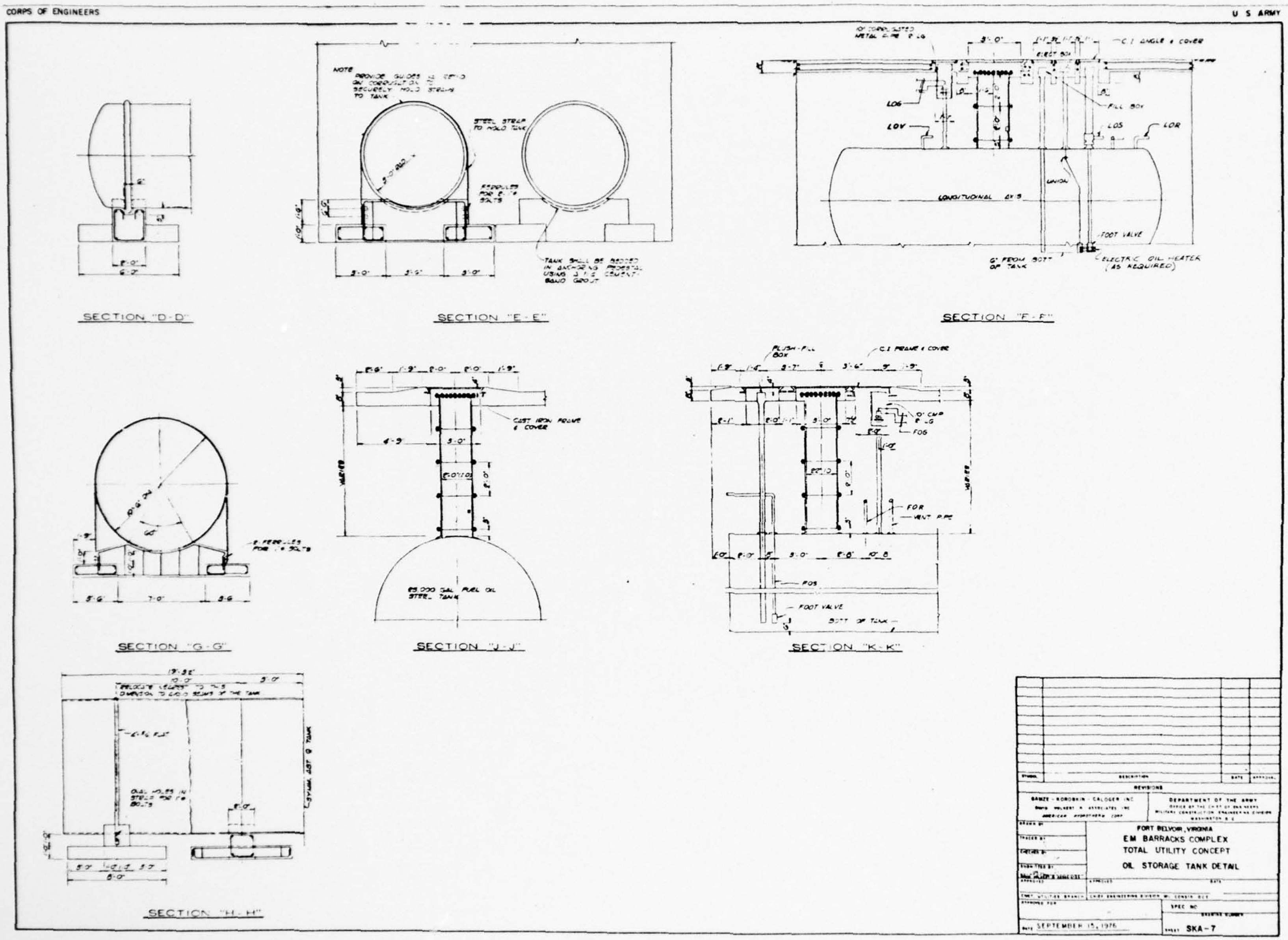


CORPS OF ENGINEERS
U. S. ARMY
ROOF PLAN
INCINERATOR AREA SEE DETAIL BELOW
COOLING TOWER
STRUCT TUBING
OVERFLOW SCUPPER
EXHAUST FAN
RADIATORS
SHEET METAL DOWN PIPE
ROOF ACCESS HATCH
LOUVER DETAIL
REINFORCED CONC LINTEL
ROLL UP DOOR DETAIL
STEEL ANGLES
TYPICAL REINFORCED CONCRETE PILASTER
REINFORCEMENT AS REQUIRED
WIDTH OF PILASTER
COPING DETAIL
TERRA COTTA
CONCRETE BLOCK
WALL DETAIL
GALVANIZED LEDGER ANGLE
FIRST FLOOR PLAN
40'-0" x 30'-0" INCINERATOR AREA
PILASTER SEE DET ABOVE
SEWAGE TREATMENT AREA SEE FIRST FL PLAN
ROOF PLAN
COOLING TOWER AREA SEE ROOF PLAN
AIR INTAKE OPNG
INCINERATOR AREA LAYOUT
SECTION "D-D"
REVISIONS
GANTZ - KOROBKIN - CALOGER INC
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
ROOF PLAN
SEPTEMBER 15, 1976
SKA-3


CORPS OF ENGINEERS
U S ARMY
TYPICAL FACE BRICK/BLOCK
LEFT ELEVATION
RIGHT ELEVATION
CONTROL JOINTS
CONT JT
FRONT ELEVATION
CONTROL JOINTS
REAR ELEVATION
SYMBOL
DESCRIPTION
DATE
APPROVAL
REVISIONS
GANZE - KOROBKIN - CALOGER INC
DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON D C
DRAWN BY
TRACED BY
CHECKED BY
SUBMITTED BY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
ELEVATIONS
APPROVED
APPROVED
DATE
CHIEF, UTILITIES BRANCH
CHIEF ENGINEERING DIVISION MIL CONSTR OCE
APPROVED FOR
SPEC NO
DRAWING NUMBER
DATE SEPTEMBER 15, 1976
SHEET SKA-4


CORPS OF ENGINEERS
U. S. ARMY
OFFICE ROOM
TOILET AREA
ACOUSTICAL WINDOWS
CONTROL ROOM 2ND FLOOR PLAN
TOP OF COPING
FLASHING
EXPOSED CONCRETE BLOCK
SUSPENDED ACOUSTICAL CEILING
FIN. 1ST FLOOR
SECTION "A - A"
COOLING TOWER AREA
SEWAGE TREATMENT AREA
INCINERATOR AREA
SECTION E-E
COOLING TOWER
PILASTER
LANDING
STEEL STAIRS
STIFFENER
SEWAGE TREATMENT AREA
SECTION "B-B"
OVERFLOW SCUPPER
SECTION "C-C"
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
CROSS SECTIONS
SEPTEMBER 15, 1976
SKA-5


CORPS OF ENGINEERS
U. S. ARMY
LOCATION PLAN OF FUEL TANKS
PAVEMENT & REINFORCING PLAN
SECTION "A-A"
SECTION "B-B"
SECTION "C-C"
BUILDING WALL
DIESEL OIL TANK
FUEL OIL FILL
PUMP OUT
FILL
REINFORCING STEEL AS REQD
REINF STEEL AS REQD
EDGE PAINTED WITH BITUMEN
ADDITIONAL REINF STEEL AS REQD
REINFORCING SUMM ABT ℄ SLAB EXCEPT OPENINGS
DOWELS
CONSTR JT
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
OIL TANK
PAVEMENT AND REINFORCING PLAN
DEPARTMENT OF THE ARMY
REVISIONS
SCALE
SEPTEMBER 15, 1976
SKA-6


CORPS OF ENGINEERS
U S ARMY
SECTION "D-D"
SECTION "E-E"
SECTION "F-F"
SECTION "G-G"
SECTION "J-J"
SECTION "K-K"
SECTION "H-H"
STEEL STRAP TO HOLD TANK
C.I. ANGLE & COVER
FILL BOX
LOS
LOR
LOV
UNION
LONGITUDINAL
FOOT VALVE
ELECTRIC OIL HEATER (AS REQUIRED)
6" FROM BOTT OF TANK
CAST IRON FRAME & COVER
25,000 GAL FUEL OIL STEEL TANK
PUSH-FILL BOX
C.I. FRAME & COVER
FOS
FOR
VENT PIPE
BOTT OF TANK
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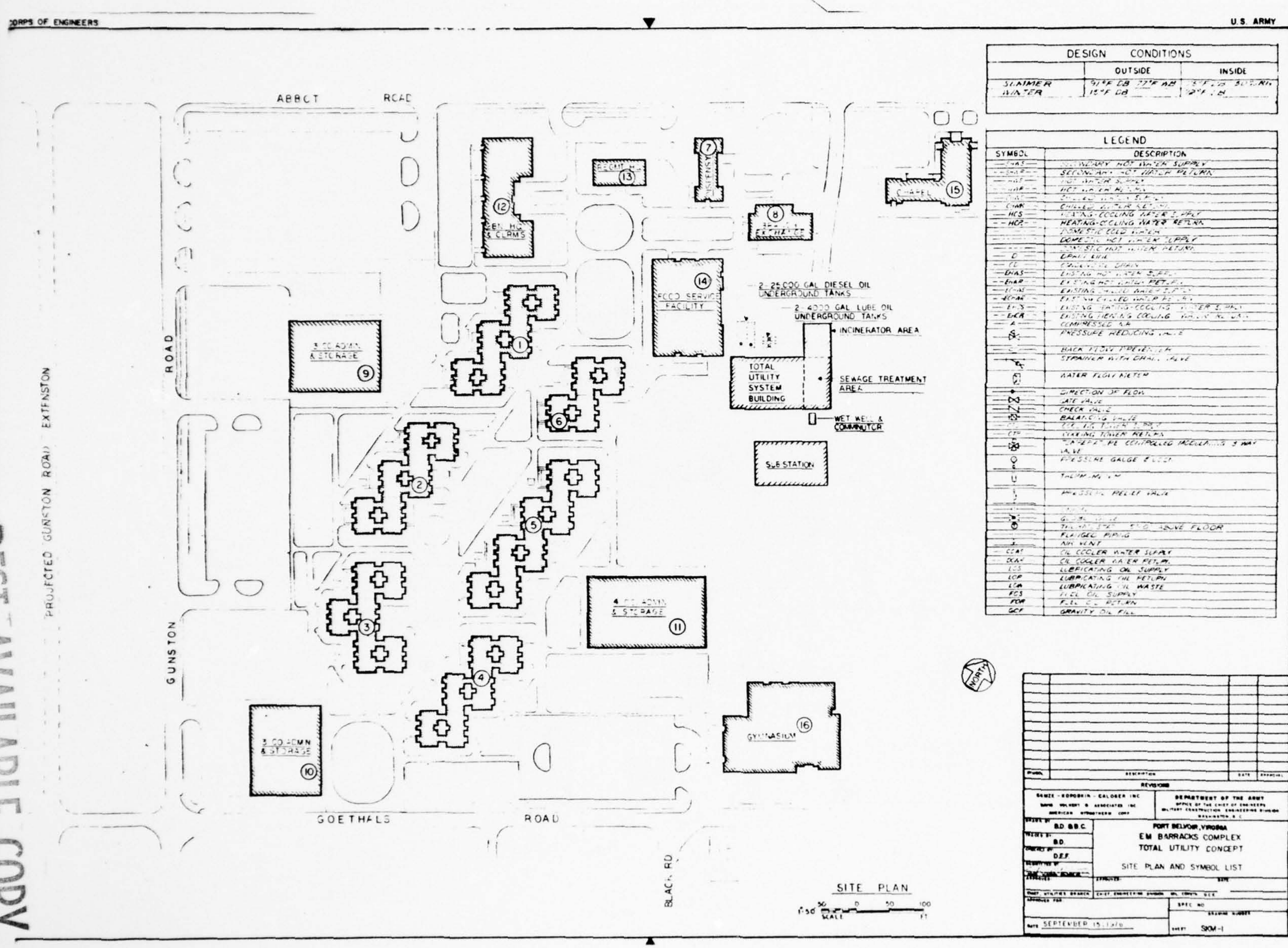
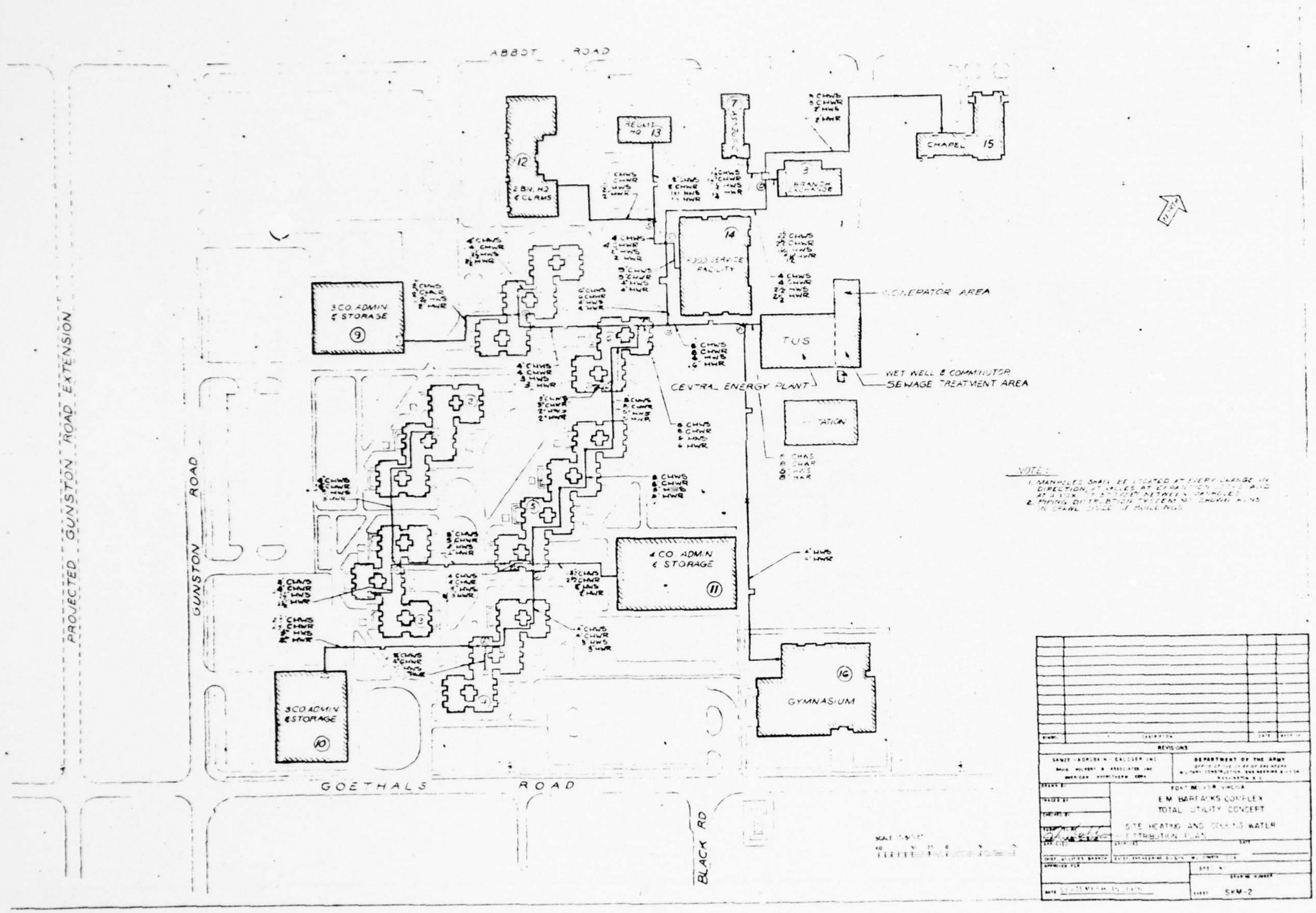
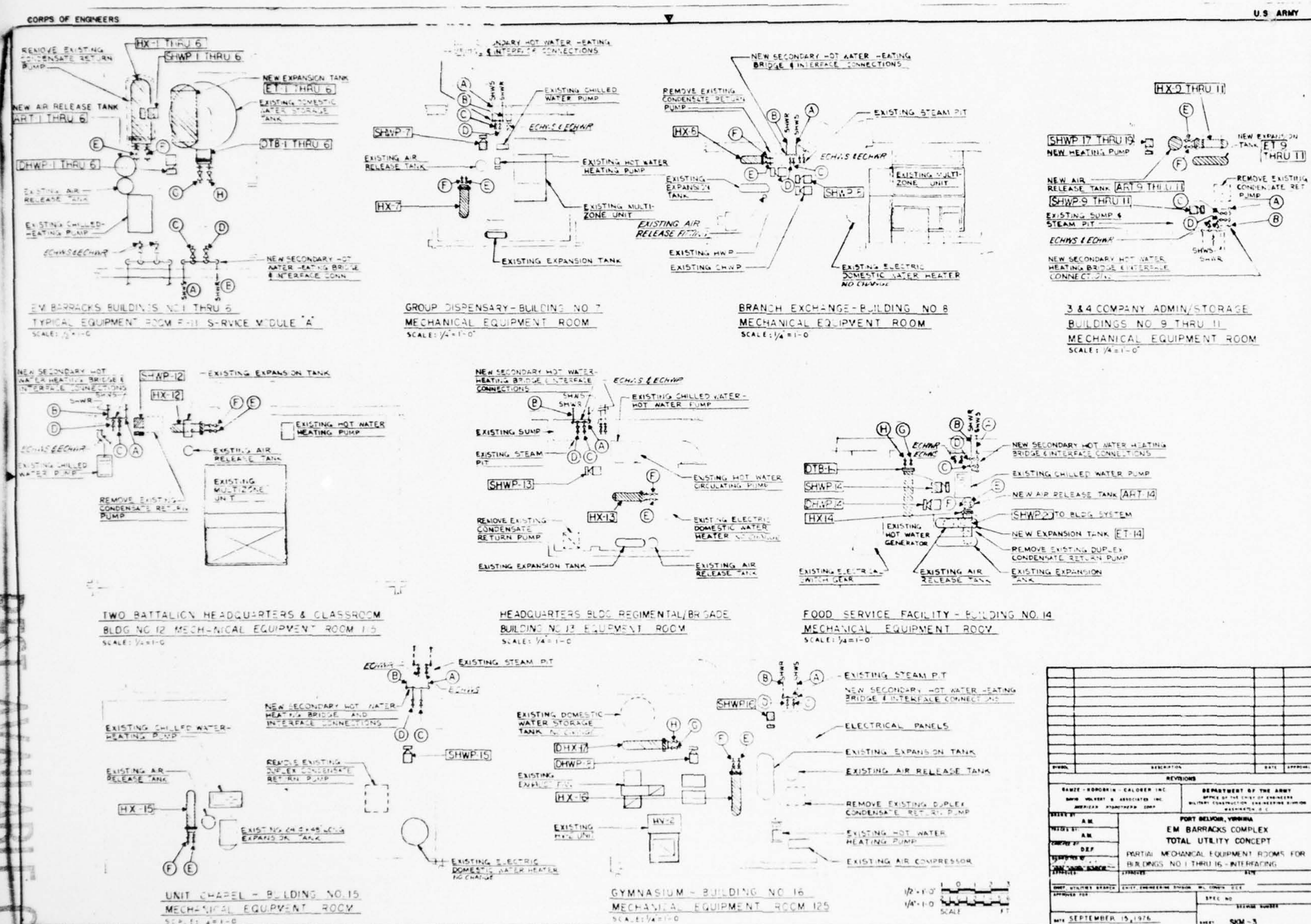
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
OIL STORAGE TANK DETAIL
SEPTEMBER 15, 1976
SKA-7


CORPS OF ENGINEERS
U.S. ARMY
DESIGN CONDITIONS
OUTSIDE
INSIDE
SUMMER
WINTER
91°F DB
LEGEND
SYMBOL
DESCRIPTION
HEATING-COOLING WATER RETURN
COMPRESSED AIR
WATER FLOW METER
DIRECTION OF FLOW
CHECK VALVE
FLANGED PIPING
AIR VENT
OIL COOLER WATER SUPPLY
LUBRICATING OIL SUPPLY
LUBRICATING OIL WASTE
GRAVITY OIL FILL
ABBOT ROAD
GUNSTON ROAD
GOETHALS ROAD
BLACK RD
PROJECTED GUNSTON ROAD EXTENSTON
GEN. HQ & CLRMS
FOOD SERVICE FACILITY
2- 25,000 GAL DIESEL OIL UNDERGROUND TANKS
2- 4000 GAL LUBE OIL UNDERGROUND TANKS
INCINERATOR AREA
TOTAL UTILITY SYSTEM BUILDING
SEWAGE TREATMENT AREA
WET WELL & COMMINUTOR
SUB STATION
CHAPEL
GYMNASIUM
4 CO ADMIN & STORAGE
3 CO ADMIN & STORAGE
NORTH
SITE PLAN
SCALE
REVISIONS
DEPARTMENT OF THE ARMY
PORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SITE PLAN AND SYMBOL LIST
SEPTEMBER 15, 1976
SKM-1


ABBOT ROAD
GUNSTON ROAD
PROJECTED GUNSTON ROAD EXTENSION
GOETHALS ROAD
BLACK RD
12 2 BN. HQ & CLASS
REGATT HQ 13
7
CHAPEL 15
3 BRANCH EXCHANGE
14 FOOD SERVICE FACILITY
GENERATOR AREA
TUS
WET WELL & COMMINUTOR
SEWAGE TREATMENT AREA
CENTRAL ENERGY PLANT
3 CO. ADMIN & STORAGE 9
4 CO. ADMIN & STORAGE 11
3 CO. ADMIN & STORAGE 10
16 GYMNASIUM
NOTE:
REVISIONS
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
E.M. BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SITE HEATING AND COOLING WATER DISTRIBUTION PLAN
SKM-2



CORPS OF ENGINEERS
U.S. ARMY
EM BARRACKS BUILDINGS NO 1 THRU 6
TYPICAL EQUIPMENT ROOM FOR SERVICE MODULE "A"
GROUP DISPENSARY - BUILDING NO 7
MECHANICAL EQUIPMENT ROOM
SCALE: 1/4"=1'-0"
BRANCH EXCHANGE - BUILDING NO 8
MECHANICAL EQUIPMENT ROOM
SCALE: 1/4"=1'-0
3 & 4 COMPANY ADMIN/STORAGE
BUILDINGS NO 9 THRU 11
MECHANICAL EQUIPMENT ROOM
SCALE: 1/4"=1'-0"
TWO BATTALION HEADQUARTERS & CLASSROOM
BLDG NO 12 MECHANICAL EQUIPMENT ROOM 1.5
HEADQUARTERS BLDG REGIMENTAL/BRIGADE
BUILDING NO 13 EQUIPMENT ROOM
SCALE: 1/4"=1'-0
FOOD SERVICE FACILITY - BUILDING NO. 14
MECHANICAL EQUIPMENT ROOM
SCALE: 1/4"=1'-0"
UNIT CHAPEL - BUILDING NO. 15
MECHANICAL EQUIPMENT ROOM
GYMNASIUM - BUILDING NO 16
MECHANICAL EQUIPMENT ROOM 125
NEW SECONDARY HOT WATER HEATING BRIDGE & INTERFACE CONNECTIONS
EXISTING STEAM PIT
EXISTING EXPANSION TANK
EXISTING CHILLED WATER PUMP
NEW EXPANSION TANK
NEW AIR RELEASE TANK
REMOVE EXISTING CONDENSATE RETURN PUMP
EXISTING HOT WATER HEATING PUMP
EXISTING AIR RELEASE TANK
ELECTRICAL PANELS
EXISTING AIR COMPRESSOR
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
PARTIAL MECHANICAL EQUIPMENT ROOMS FOR BUILDINGS NO 1 THRU 16 - INTERFACING
SEPTEMBER 15, 1976
SKM-3
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CORPS OF ENGINEERS | U.S. ARMY

BEST AVAILABLE COPY

WATER TO WATER HEAT EXCHANGER [illegible]

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	EQUIPMENT LOCATION	SHELL SECTION GPM	ENT WTR TEMP °F	LVG WTR TEMP °F	PRES DROP FT H2O	TUBE [illegible] SECTION CAPACITY MBH*	GPM	ENT WTR TEMP °F	LVG WTR TEMP °F	PRES DROP FT H2O	SQ FT HEATING SURFACE	FOULING FACTOR	REMARKS
HE-1	BUILDING NO 1 EM BARRACKS	SERVICE MODULE A MECH ROOM F.U.	27	215	180°	2.0'	1206.5	93.0	[illegible]	180°	2.0'	126	.0005	
HE-2	BUILDING NO 2 EM BARRACKS	SERVICE MODULE A MECH ROOM	27	215	180°	2.0'	1206.5	93.0	167.5	180°	2.0'	126	.0005	
HE-3	BUILDING NO 3 EM BARRACKS	SERVICE MODULE A MECH ROOM	49	215°	180°	2.0'	1208.3	93.3	167.5	180°	2.0'	126	.0005	
HE-4	BUILDING NO 4 EM BARRACKS	SERVICE MODULE A MECH ROOM	49	215°	150	2.0'	1208.3	93.3	167.5°	160°	2.0'	126	.0005	
HE-5	BUILDING NO 5 EM BARRACKS	SERVICE MODULE A MECH ROOM	33	215°	180°	2.0'	1624.0	433.0	172.5	160°	2.5'	222	.0005	
HE-6	BUILDING NO 6 EM BARRACKS	SERVICE MODULE A MECH ROOM	46	215°	180	2.0'	812.3	33.8	165.0	180°	1.5'	66	.0005	
HE-7	BUILDING NO 7 [illegible]	MECHANICAL EQUIPMENT ROOM	8	215°	180°	3.0'	34.0	3.4	160°	180°	2.0'	22	.0005	
HE-8	BUILDING NO 8 BRANCH EXCHANGE	MECHANICAL EQUIPMENT ROOM	3	215°	180°	10.5'	329.0	14.9	160°	180	3.0'	75	.0005	
HE-9	BUILDING NO 9 100 ADMIN/STOR	MECH EQUIP ROOM 40	24	215°	180	3.0'	49.7	4.9	160°	180°	2.5'	41	.0005	
HE-10	BUILDING NO 10 300 ADMIN/STOR	MECH EQUIP ROOM 140	24	215	180	3.0'	49.7	4.9	160	180°	2.5'	41	.0005	
HE-11	BUILDING NO 11 400 ADMIN/STOR	MECH EQUIP ROOM 53	31	215°	180	5.0'	545.2	54.5	160°	180°	5.0'	58	.0005	
HE-12	BUILDING NO 12 [illegible]	MECH EQUIP ROOM [illegible]	25	215°	180	12.0'	438.7	43.8	160	180	2.0'	220	.0005	
HE-13	BUILDING NO 13 HQ REGM/BRIG	BASEMENT FLR MECH [illegible]	13	215	180	7.5'	220.5	22.0	160°	180°	2.0'	110	.0005	
HE-14	BUILDING NO 14 FOOD SERVICE FAC	MECH EQ RM	185	215°	180°	11.0'	3250.2	295.4	155	180°	2.0	337	.0005	
HE-15	BUILDING NO 15 [illegible] CHAPEL	BASEMENT MECH EQ RM	23	215	180	6.0'	315.7	79.1	170°	180°	7.0'	110	.0005	
HE-16	BUILDING NO 16 GYMNASIUM	MECH EQ RM 125	119	215	180	9.0'	[illegible]8.4	34	140°	180°	2.5'	212	.0005	
CHE-17	BUILDING NO 16 GYMNASIUM	MECH EQUIPMENT ROOM 125	10	215	180	6.0'	26.6	4.2	40°	120°	1.0'	22	.0005	

* CAPACITY INCLUDES DIVERSITY

DOMESTIC HOT WATER TUBE BUNDLE SCHEDULE

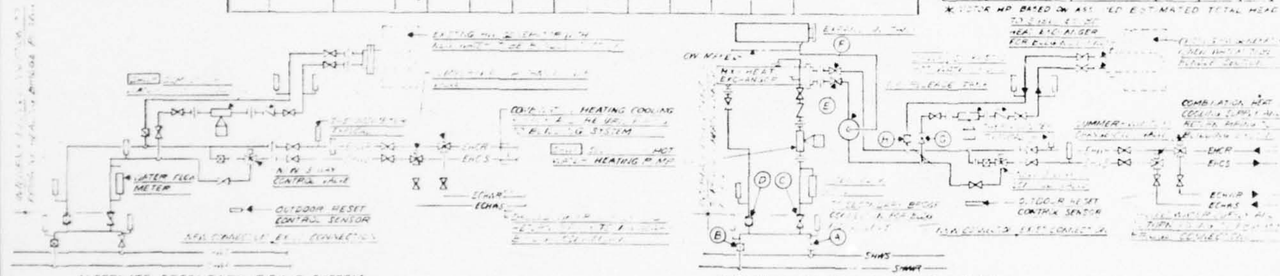
40° ENT WATER TEMP
140° LVG WATER TEMP

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	EQUIPMENT ROOM NUMBER	STORAGE TANK SIZE DIA	LENGTH FT	GALLONS	TUBE BUNDLE SECTION GPM	ENT WTR TEMP	LVG WTR TEMP	CAPACITY MBH	PRES DROP FT H2O	SQ FT HEATING SURFACE	FOULING FACTOR	REMARKS
DTB-1	BUILDING NO 1 EM BARRACKS	SERVICE MODULE A MECH ROOM	48"	8'-0	VERTICAL	35.0	180°	151.4	500.0	3.3'	75	.0005	
DTB-2	BUILDING NO 2 EM BARRACKS	SERVICE MODULE A MECH ROOM	48"	8'-0	VERTICAL	35.0	180°	151.4	500.0	3.3'	75	.0005	
DTB-3	BUILDING NO 3 EM BARRACKS	SERVICE MODULE A MECH ROOM	48"	8'-0	VERTICAL	35.0	180°	151.4	500.0	3.3'	75	.0005	
DTB-4	BUILDING NO 4 EM BARRACKS	SERVICE MODULE A MECH ROOM	48"	8'-0	VERTICAL	35.0	180°	151.4	500.0	3.3'	75	.0005	
DTB-5	BUILDING NO 5 EM BARRACKS	SERVICE MODULE A MECH ROOM	48"	8'-0	VERTICAL	85.0	180°	160.6	775.0	3.3'	177	.0005	
DTB-6	BUILDING NO 6 EM BARRACKS	SERVICE MODULE A MECH ROOM	40"	7'-0	VERTICAL	23.8	180°	156.1	245.0	3.2'	41	.0005	
DTB-7	BUILDING NO 14 FOOD SERVICE FAC	[illegible]	72"	10'-0	HORIZONTAL 1000	65.4	180°	47.2	1040.0	0.5'	222	.0005	

PUMP SCHEDULE

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	EQUIPMENT LOCATION	TOTAL GPM	TOTAL HEAD FT H2O	MOTOR DATA HP	RPM	VOLT	PHASE	TEMP RATING °F	IMPELLER SIZE	EFFICIENCY	REMARKS
SHWP-1	BUILDING NO 1 EM BARRACKS	SERVICE MODULE A MECH ROOM F.U.	[illegible]	15	[illegible]	1750	208	3φ	215°	5"	50%	IN-LINE TYPE W/SUPPORT MOUNTED BRACKETS
SHWP-2	BUILDING NO 2 EM BARRACKS	SERVICE MODULE A MECH ROOM	[illegible]	15	1/2					5"	55%	
SHWP-3	BUILDING NO 3 EM BARRACKS	SERVICE MODULE A MECH ROOM	49	15	1/2					5"	55%	
SHWP-4	BUILDING NO 4 EM BARRACKS	SERVICE MODULE A MECH ROOM	49	15	1/2					5"	55%	
SHWP-5	BUILDING NO 5 EM BARRACKS	SERVICE MODULE A MECH ROOM	33	15	3/4		208	3φ		4 1/8"	55%	
SHWP-6	BUILDING NO 6 EM BARRACKS	SERVICE MODULE A MECH ROOM	46	15	1/2		120	1φ		4 3/4"	54%	
SHWP-7	BUILDING NO 7 [illegible]	MECHANICAL EQUIPMENT ROOM	8	2	1/4					4"	25%	
SHWP-8	BUILDING NO 8 BRANCH EXCHANGE	MECHANICAL EQUIPMENT ROOM	3	15	1/4					4 1/4"	42%	
SHWP-9	BUILDING NO 9 [illegible]	MECH EQUIP ROOM	24	12	1/4					4 1/8"	45%	
SHWP-10	BUILDING NO 10 [illegible]	MECH EQUIP ROOM	24	12	1/4					4 7/8"	45%	
SHWP-11	BUILDING NO 11 [illegible]	MECH EQUIP ROOM	31	12	1/4					4 1/2"	48%	
SHWP-12	BUILDING NO 12 [illegible]	MECH EQUIP ROOM	25	15	1/4					4 5/8"	47%	
SHWP-13	BUILDING NO 13 [illegible]	MECH EQUIP ROOM	13	15	1/4		120	1φ		4 1/4"	36%	
SHWP-14	BUILDING NO 14 [illegible]	[illegible]	185	20	2		208	3φ		5 5/8"	60%	
SHWP-15	BUILDING NO 15 [illegible]	BASEMENT [illegible]	23	15	1/4		120	1φ		4 5/8"	47%	
SHWP-16	BUILDING NO 16 GYMNASIUM	MECH EQUIP RM 125	9	20	1	1750	208	3φ	215°	5 1/2"	58%	
CHWP-1	BUILDING NO 1 EM BARRACKS	SERVICE MODULE A MECH ROOM	35.0	10	1/4	1750	120	1φ	80°	[illegible]	[illegible]	
CHWP-2	BUILDING NO 2 EM BARRACKS	SERVICE MODULE A MECH ROOM	35.0	10	1/4					4 5/8	45%	
CHWP-3	BUILDING NO 3 EM BARRACKS	SERVICE MODULE A MECH ROOM	35.0	10	1/4					4 5/8	45%	
CHWP-4	BUILDING NO 4 EM BARRACKS	SERVICE MODULE A MECH ROOM	35.0	10	1/4					4 5/8	45%	
CHWP-5	BUILDING NO 5 EM BARRACKS	SERVICE MODULE A MECH ROOM	80.0	10	1/2					4 1/2	51%	
CHWP-6	BUILDING NO 6 EM BARRACKS	SERVICE MODULE A MECH ROOM	23.8	10	1/4					3 5/8	40%	
CHWP-7	[illegible]	MECH EQUIP RM	43.[illegible]	2	1/2					4 1/4	51%	
CHWP-8	[illegible]	MECH EQUIPMENT ROOM 125	10.0	12	1/4	750	120	1φ	180°	4"	30%	
SHWP-[illegible]	[illegible]	MECHANICAL EQUIPMENT [illegible]	41.9	30	3/4	750	208	3φ	180°	6"	49%	
SHWP-[illegible]	[illegible]	MECHANICAL EQUIPMENT [illegible]	41.9	30	3/4					5 1/2	52%	
SHWP-[illegible]	[illegible]	MECHANICAL EQUIPMENT [illegible]	54.5	32	1					5 3/4	54%	
SHWP-[illegible]	[illegible]	[illegible]	232.0	30	5	1750	208	3φ	180°	7"	69%	IN-LINE TYPE W/SUPPORT MOUNTED BRACKETS

* MOTOR HP BASED ON ASSUMED ESTIMATED TOTAL HEAD



SEPARATE HOT WATER HEAT EXCHANGER HOT WATER SYSTEM [illegible] PIPING [illegible] FOR [illegible]
NO 1 THRU 6, [illegible] THRU 15 [illegible] TYPICAL LESS [illegible]
HOT WATER GENERATOR (DOMESTIC WATER SYSTEM ELECTRIC, BLDG NO 16 NO
COOLING) (BLDG NO 7 [illegible]) NO SCALE

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

GANZE - KORORKIN - CALOGER INC
DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON D.C.

DRAWN BY B.C.
TRACED BY B.C.
CHECKED BY DEF
SUBMITTED BY

FORT BELVOIR, VIRGINIA
E.M. BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
MECHANICAL SCHEDULES AND INTERFACING PIPING DIAGRAMS

APPROVED | APPROVED | DATE
CHIEF, UTILITIES BRANCH | CHIEF ENGINEERING DIVISION, MIL CONSTN, OCE
APPROVED FOR
SPEC NO
DRAWING NUMBER
DATE SEPTEMBER 15, 1976
SHEET SKM-4

CORPS OF ENGINEERS

U.S. ARMY

HEATING COIL SCHEDULE

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	SERVICE	CFM	MIN FA °F	COIL SIZE	HEATING CAPACITY MBH	TOTAL GPM	[illegible]	[illegible]	LVG AIR TEMP	NO OF ROWS	COIL SERIES	MAX AIR FRIC LOSS	ENT WATER TEMP	LVG WATER TEMP	REMARKS	WATER PRESS DROP
HC-9-1	Building No 9 300 Administr	Admin Office #1 AHU-1 Unit	2[illegible]	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-9-2	Building No 9 [illegible]	Admin Office #2 AHU-2 Unit	23[illegible]	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-9-3	Building No 9 300 Administr	Admin Office #3 AHU-3 Unit	2300	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-10-1	Building No 10 300 Administr	Admin Office #1 AHU-1 Unit	2300	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-10-2	Building No 10 300 Administr	Admin Office #2 AHU-2 Unit	2300	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-10-3	Building No 10 300 Administr	Admin Office #3 AHU-3 Unit	2300	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-11-1	Building No 11 400 Administr	Admin Office #1 AHU-1 Unit	230[illegible]	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-11-2	Building No 11 400 Administr	Admin Office #2 AHU-2 Unit	230[illegible]	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-11-3	Building No 11 400 Administr	Admin Office #3 AHU-3 Unit	230[illegible]	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-11-4	Building No 11 400 Administr	Admin Office #4 AHU-4 Unit	230[illegible]	56	18x45	738	45	408	65.7°	953	1	15	.08	180°F	147.2		8.9
HC-14-1 HC-14-2	Building No 14 Food Service Fac	Dining/Serving MZU-1 Preheat	[illegible]	24	18x99	816.8	72.5	1082	55.0°	111.2	2	18	1.1	180°F	157.5	MZU-2 Unit Typical	6.6
HC-14-3	Building No 14 Food Service Fac	Kitchen Area MZU-1 Reheat	[illegible]	20.6	30x99	350.6	2275	512	45.0°	75.6	1	15	.13	180°F	146.2	Reheat	2.0
HC-14-4	Building No 14 Food Service Fac	Kitchen Area MZU-2 Reheat	21,150	40.5	24x108 36x108	[illegible]	4.50	522	45.0°	75.6	1	15	.13	180°F	146.2	Reheat	2.5
PHC-14-1 PHC-14-2	Building No 14 Food Service Fac	Dining/Serving MZU-1 Preheat	12,3[illegible]	24.1	33x105	497.7	3000	556	35.0°	68.0	1	15	.15	180°F	[illegible]	MZU-2 Unit Typical	3.4
PHC-14-3	Building No 14 Food Service Fac	Kitchen Area MZU-1 Preheat	11,575	20.6	30x99	453.0	2910	512	17.0°	56.5	1	15	.13	180°F	148.9	Preheat	3.7
PHC-14-4	Building No 14 Food Service Fac	Kitchen Area MZU-2 Preheat	21,150	40.5	24x108 30x108	913.3	5820	522	17.0°	56.8	1	15	.13	180°F	149.9	Preheat	5.0

(SYSTEM NO 1 ONLY) AIR RELEASE TANK / EXPANSION TANK

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	EQUIPMENT LOCATION	TOTAL GPM	AIR RELEASE TANK SIZE DIA	AIR RELEASE TANK SIZE HEIGHT	PIPE SIZES IN	PIPE SIZES OUT	PIPE SIZES A.R.	EXPANSION TANK SIZE DIA	EXPANSION TANK SIZE LENGTH	EXPANSION TANK SIZE GALLONS	REMARKS
ART-1 ET-1	Building No 1 EM Barracks	Service Module A Mech Room [illegible]	[illegible]0	12 3/4"	30 3/4"	4	4	[illegible]	20 1/4"	82"	100	
ART-2 ET-2	Building No 2 EM Barracks	Service Module A Mech Room [illegible]	[illegible]	12 3/4	30 3/4"	4	4"	1 1/2"	20 1/4"	82	100	
ART-3 ET-3	Building No 3 EM Barracks	Service Module A Mech Room [illegible]	1930	12 3/4"	30 3/4"	4	4	1 1/2"	20 1/4	82	100	
ART-4 ET-4	Building No 4 EM Barracks	Service Module A Mech Room [illegible]	1930	12 3/4"	30 3/4"	4"	4	1 1/2"	20 1/4"	82	100	
ART-5 ET-5	Building No 5 EM Barracks	Service Module A Mech Room [illegible]	4330	16"	36 1/8"	5"	5"	1 1/2"	24 1/4"	[illegible]3 1/2"	144	
ART-6 ET-6	Building No 6 EM Barracks	Service Module A Mech Room [illegible]	1330	10 3/4	25 11/16"	3"	3"	1 1/4"	20 1/4"	63"	80	
	Building No 7 [illegible]			EXISTING					EXISTING			
	Building No 8 [illegible]			EXISTING					EXISTING			
ART-9 ET-9	Building No 9 300 Administr	Mech Equip Room 140	41.9	6 5/8	15 7/8	2	2"	1"	16 1/4	76 1/2	60	
ART-10 ET-10	Building No 10 300 Administr	Mech Equip Room 140	41.9	6 5/8	15 7/8	2"	2"	1"	16 1/4	76 1/2	60	
ART-11 ET-11	Building No 11 400 Administr	Mech Equip Room 53	54.2	8 5/8	17 7/8	2 1/2	2 1/2	1"	16 1/4"	76 1/2"	60	
	Building No 1[illegible] [illegible]			EXISTING					EXISTING			
	Building No 1[illegible] [illegible]			EXISTING					EXISTING			
ART-14 ET-14	Building No 14 Food Service Fac	Mech Equip Room	295.4	[illegible]	36 1/8	5	5	1 1/2	20 1/4"	82	100	
	Building No 15 Chapel			EXISTING					EXISTING			
	Building No 16 Gymnasium			EXISTING					EXISTING			

(SYSTEM NO 1 ONLY) PIPE SIZE SCHEDULE

BUILDING NUMBER AND DESCRIPTION	LOCATION	A	B	C	D	E	F	G	H	J	K	REMARKS
Building No 1 EM Barracks	Service Module A [illegible]	2 1/2"	2 1/2"	2 1/2"	2 1/2"	4	4	2"	2"			
Building No 2 EM Barracks	Service Module A [illegible]	2 1/2"	2 1/2"	2 1/2"	2 1/2"	4	4"	2"	2"			
Building No 3 EM Barracks	[illegible]	2 1/2	2 1/2"	2 1/2	2 1/2	4	4	2	2"			
Building No 4 EM Barracks	[illegible]	2 1/2	2 1/2	[illegible]	[illegible]	4	4	2	2			
Building No 5 EM Barracks	[illegible]	3	3	3	3	5	5"	3"	3"			
Building No 6 EM Barracks	Service Module A [illegible]	2"	2"	2"	2"	3	3"	2"	2			
Building No 7 [illegible]	[illegible]	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/4	-	-			
Building No 8 [illegible]	Mechanical [illegible]	1 1/2	1 1/2"	1 1/2"	1 1/2	2"	2"	-	-			
Building No 9 300 [illegible]	[illegible]	2"	2"	2"	2"	2	2	-	-			
Building No 10 300 Admin [illegible]	[illegible]	2"	2"	2"	2	2"	2"	-	-			
Building No 11 400 [illegible]	[illegible]	2"	2"	2"	2"	2 1/2	2 1/2	-	-			
Building No [illegible]	[illegible]	[illegible]	2"	2	2"	2"	2	-	-			
Building No 1[illegible] [illegible]	[illegible]	1 1/4"	1 1/4"	1 1/4"	1 1/4"	1 1/2"	1 1/2"	-	-			
Building No 14 Food Service [illegible]	[illegible]	4"	4"	4	4	5"	5"	2 1/2	2 1/2			
Building No 15 Chapel [illegible]	[illegible]	2"	2	2"	2"	[illegible]	3	-	-			
Building No 16 Gymnasium	Mech [illegible]	3"	3"	3	3	3	3	1 1/4"	1 1/4"			

UNIT HEATER SCHEDULE

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	LOCATION	CFM	HEATING CAPACITY MBH	ENT AIR TEMP	LVG AIR TEMP	ENT WATER TEMP	LVG WATER TEMP	FAN HP	FAN RPM	REMARKS
UH-1	Building No 9 300 Administr	Storage Rm 1	600	[illegible]	65°F	134.5	180°F	160°F	1/8	1100	
UH-2	Building No 9 300 Administr	Storage Rm 2	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-3	Building No 9 300 Administr	Storage Rm 3	600	600	65°F	134.5	[illegible]	160°F	1/8	1100	
UH-4	Building No 10 300 Administr	Storage Rm 1	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-5	Building No 10 300 Administr	Storage Rm 2	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-6	Building No 10 300 Administr	Storage Rm 3	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-7	Building No 11 400 Administr	Storage Rm 1	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-8	Building No 11 400 Administr	Storage Rm 2	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-9	Building No 11 400 Administr	Storage Rm 3	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-10	Building No 11 400 Administr	Storage Rm 4	600	600	65°F	134.5	180°F	160°F	1/8	1100	
UH-11	Building No 14 Food Service Fac	Kitchen Area	600	420	65°F	129°F	180°F	160°F	1/8	1100	

REVISIONS

SYMBOL	DESCRIPTION	DATE	APPROVAL

GANZE · KOROBKIN · CALOGER INC
DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON, D.C.

FORT BELVOIR, VIRGINIA
E.M. BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
MECHANICAL SCHEDULES

DRAWN BY: B.C.
TRACED BY: B.C.
CHECKED BY: D.E.F.
SUBMITTED BY:
APPROVED
DATE
CHIEF, UTILITIES BRANCH
CHIEF, ENGINEERING DIVISION
APPROVED FOR
SPEC NO
DRAWING NUMBER
DATE: SEPTEMBER 15, 1976
SHEET: SKM-5

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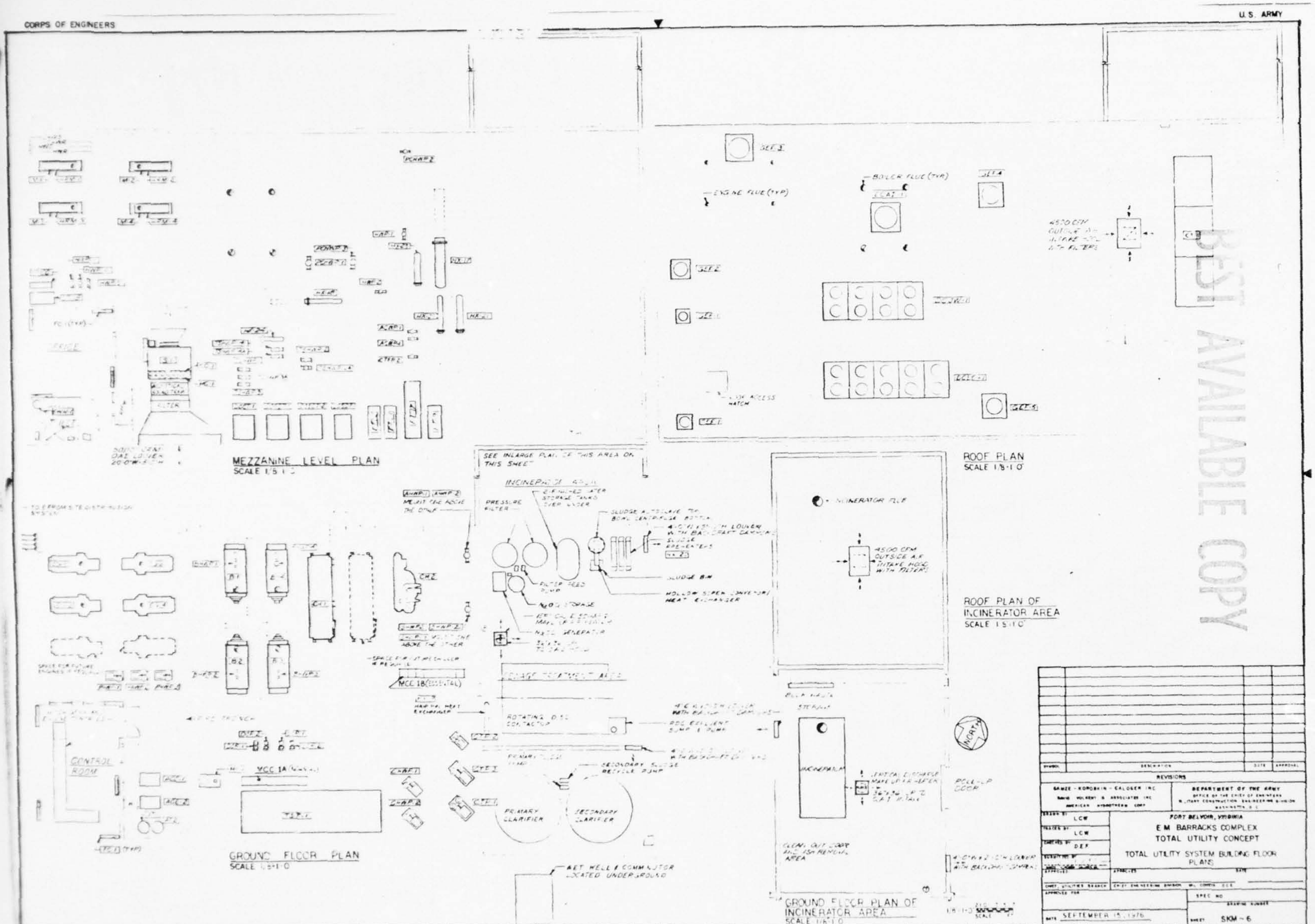
CORPS OF ENGINEERS
U.S. ARMY
MEZZANINE LEVEL PLAN
SCALE 1/8"-1'-0"
GROUND FLOOR PLAN
SCALE 1/8"-1'-0"
ROOF PLAN
SCALE 1/8"-1'-0"
ROOF PLAN OF INCINERATOR AREA
SCALE 1/8"-1'-0"
GROUND FLOOR PLAN OF INCINERATOR AREA
SCALE 1/8"-1'-0"
CONTROL ROOM
PRIMARY CLARIFIER
SECONDARY CLARIFIER
ROTATING DISC CONTACTOR
INCINERATOR
MCC 1A
MCC 1B (ESSENTIAL)
SEE INLARGE PLAN OF THIS AREA ON THIS SHEET
WET WELL & COMMINUTOR LOCATED UNDERGROUND
BOILER FLUE (TYP)
ENGINE FLUE (TYP)
INCINERATOR FLUE
4500 CFM OUTSIDE AIR INTAKE HOOD WITH FILTERS
REVISIONS
GANZE - KOROBKIN - CALOGER INC
DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON, D.C.
FORT BELVOIR, VIRGINIA
E M BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
TOTAL UTILITY SYSTEM BUILDING FLOOR PLANS
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AD-A038 722 GAMZE-KOROBKIN-CALOGER INC CHICAGO ILL F/G 13/13
PRELIMINARY DESIGN OF A TOTAL UTILITY PILOT DEMONSTRATION PROJE--ETC(U)
SEP 76 L KOROBKIN DACA73-75-C-0002
UNCLASSIFIED USAFESA-RT-2030 NL

4 OF 4
AD
A038722

END
DATE
FILMED
5-77

CORPS OF ENGINEERS — U.S. ARMY

WATER TO WATER HEAT [illegible] SCHEDULE

TAG NUMBER	BUILDING NUMBER AND DESCRIPTION	EQUIPMENT LOCATION	SHELL SECTION GPM	ENT WTR TEMP °F	LVG WTR TEMP °F	PRESS DROP FT H2O	TUBE [illegible]	GPM	BUNDLE SECTION ENT WTR TEMP °F	LVG WTR TEMP °F	PRES DROP FT H2O	SQ FT HEATING SURFACE	FOULING FACTOR	REMARKS
HX-17	[illegible] HEAT EXCH	TUS BUILDING	334	[illegible]	215	5.0	7609.1	1120	180	2.5	4.0	1376.0	.0005 *	GLYCOL SHELL SIDE
HX-18	[illegible] HEAT EXCHANGER	TUS BUILDING	190	70	140	[illegible]	2660.0	312	235	190	3.0	148.0	.0005 *	GLYCOL TUBE SIDE
HX-19	[illegible] TYPE HEAT EXCHANGER	TUS BUILDING	86	2.5	195	10.0	812.0	65	65	90	10.0	—	.0005 *	[illegible] GLYCOL SHELL SIDE
HX-20	SLUDGE HEAT EXCHANGER	TUS BUILDING	24	400	360	4.2	5700	4	65	350	1.0	31.5	.002	SEWAGE TREATMENT SYSTEM
HX-21	COOLING TOWER FREEZE PROTECT	TUS BUILDING	[illegible]	85	105	3.0	600.0	77	45	123	5.0	290	.0005 *	[illegible] SYSTEM GLYCOL TUBE SIDE
HX-22	EMERGENCY HEAT EXCHANGER	TUS BUILDING	62	70	120	1.0	1560.0	328	150	140	10.0	513	.0005 *	OIL COOLER SYSTEM GLYCOL TUBE SIDE
HX-23	[illegible] HEAT EXCHANGER	TUS BUILDING	70	45	75	6.0	1040.0	67	50	127	4.0	41	.0005 *	[illegible] 4 SERVICE GLYCOL TUBE SIDE
HX-24	THERMAL STORAGE HEAT EXCHANGER	TUS BUILDING	167	400	370	6.0	25100	265	230	250	11.0	96	.0005 *	[illegible] SYSTEM GLYCOL TUBE SIDE

* 25% GLYCOL SOLUTION

① PROVISION SHALL BE MADE FOR FLUSHING THE TUBES WITH CLEAN WATER AFTER EACH [illegible]

② TUBE WITHIN A [illegible] HEAT EXCHANGER SHALL HAVE DETACHABLE [illegible] SECTION AND [illegible] FOR CLEANING

③ DESIGN RATING OF SHELL & TUBES TO BE 500°F & 660 PSIG

ABSORPTION WATER CHILLER SCHEDULE

CHILLER IDENT	TONS	HEAT TRANSFER PERFORMANCE FLOW	ENT WTR TEMP	LVG WTR TEMP	GPM	PRES DROP FT WC	FOULING FACTOR	HEAT INPUT ENT HOT WTR TEMP	LVG HOT WTR TEMP	GPM	PRES DROP FT WC	ELECTRICAL DATA VOLT/PH/HZ	PUMP MOTOR DATA	F.L.A.	L.R.A.	[illegible]	REMARKS
CH-1	622	EVAP	56	45	1350	20.0	.0005	235	207	11650	4.5	460/60/3	SOL	21.5	130	15	
		ABS COND	85	102	2240	28.0	.0005						REF	-	-	-	

CENTRIFUGAL WATER CHILLER SCHEDULE

TAG NUMBER	TONS	CHILLER ENT WTR TEMP	LVG WTR TEMP	GPM	[illegible]	FOULING FACTOR	CONDENSER ENT WTR TEMP	LVG WTR TEMP	GPM	PRES DROP FT WC	FOULING FACTOR	COMPRESSOR MOTOR HP	V	HZ	PH	FLA	REMARKS
CH-2	180	56.0	45.0	260.0	18.0	.0005	85	95	360.0	20.0	.0005	105	460	60	3	1420	BASED ON 2 PASS EVAPORATOR/CONDENSER

PURGE UNIT OIL PUMP 1/4 HP MOTOR 480 VOLT 3 PHASE 60 HZ WITH CONTROL PANEL

FAN SCHEDULE

TAG NUMBER	[illegible]	[illegible]	CFM	FAN DIA	STATIC PRES.	[illegible]	FAN MOTOR HP	RPM	VOLT	PH	TYPE DRIVE	[illegible]	[illegible]	REMARKS
[illegible]	[illegible]	24 1/2	[illegible]	4500	5/8	3/4	1/3	445	120	1	V-BELT	-	[illegible]	-
[illegible]	[illegible]	24 1/2	[illegible]	5000	375	3/4	1/2	476	120	1	V-BELT	-	VERT	-
GEF-1	[illegible]	54	[illegible]	48005	1.00	5.72	7 1/2	340	480	3	V-BELT	-	VERT	-
GEF-3	[illegible]	54	[illegible]	48005	.50	2.56	3	260	480	3	V-BELT	-	VERT	-
GEF-4	[illegible]	44 1/2	[illegible]	[illegible]	.50	2.01	3	325	480	3	V-BELT	-	VERT	-
[illegible]	[illegible]	44 1/2	[illegible]	[illegible]	.50	2.01	3	325	480	3	V-BELT	-	VERT	-
[illegible]	[illegible]	[illegible]	[illegible]	2500	2.5	40.57	50	960	480	3	V-BELT	[illegible]	[illegible]	①

* MOTOR HP'S ARE BASED ON [illegible] TOTAL STATIC PRESSURE DROPS

① [illegible] COMPLETE WITH INSULATED HEATING [illegible] COOLING COIL SECTION, FAN SECTION INSULATED DRAIN PAN, MED CAPACITY FILTER SECTION WITH CLEANABLE FILTERS

EQUIPMENT SCHEDULE

NUMBER	DESCRIPTION
ECED-1	[illegible] CAPACITY [illegible] GPM FROM 150 F TO 140 F AT 100 F AMBIENT [illegible] 25% GLYCOL SOLUTION, EACH [illegible] COOLER TO HAVE (3) SEPARATE COILS. ELECTRICAL [illegible] FAN MOTORS (3) 3HP 4P [illegible] 60 HZ CLASS F MOTOR INSULATION 60°C RISE

EQUIPMENT SCHEDULE CONTINUATION

NUMBER	DESCRIPTION
OCIW-1	[illegible] CAPACITY [illegible] 200 GPM [illegible] F TO 190°F AT 100°F AMBIENT [illegible] GLYCOL SOLUTION, EACH [illegible] COOLER TO HAVE (4) SEPARATE [illegible]. ELECTRICAL [illegible] FAN MOTORS (4) 3 HP [illegible] CLASS F MOTOR INSULATION [illegible] RISE
HRM-1	HEAT RECOVERY MUFFLER [illegible]
HRM-2	HEAT RECOVERY 1380 [illegible] EXHAUST SIDE 6"
HRM-3	PD, ENTERING [illegible] 710 °F LEAVING EXHAUST
HRM-4	325°F, TUBE SIDE WATER FLOW 90 GPM

PUMP SCHEDULE

TAG NUMBER	SERVICE	EQUIPMENT TYPE	TOTAL GPM	TOTAL * HEAD FT H2O	MOTOR DATA HP	RPM	VOLT	PHASE	TEMP [illegible]	IMPELLER SIZE	PUMP EFFICIENCY	REMARKS
PHWP-1	PRIMARY HOT WATER PUMP	BASE MOUNTED	[illegible]	[illegible]	25	1750	480	3	223	10.5	80%	
PHWP-2	[illegible]	BASE MOUNTED	667	100	25	1750	480	3	223	10.5	80%	
PHWP-3	[illegible]	BASE MOUNTED	667	100	25	1750	480	3	223	10.5	80%	
BHWP-1	BOILER 1 HOT WATER PUMP	IN-LINE	380	22	5	1750	480	3	245	6.7	71%	
BHWP-2	BOILER 2 HOT WATER PUMP	IN-LINE	380	22	5	1750	480	3	245	6.7	71%	
BHWP-3	BOILER 3 HOT WATER PUMP	IN-LINE	380	22	5	1750	480	3	245	6.7	71%	
BHWP-4	BOILER B 4 [illegible]	IN-LINE	380	22	5	1750	480	3	245	6.7	71%	
AHWP-1 AHWP-2	ABSORBER CH-1 HOT WATER PUMP	IN-LINE	1165.0	30	10	1150	480	3	235	10.5	71%	AHWP-2 IS STAND-BY PUMP
SHWP-21	SECONDARY HOT WATER PUMP	IN-LINE	560	188	40	1750	480	3	215	13.5	66%	
SHWP-22	SECONDARY HOT WATER PUMP	IN-LINE	560	188	40	1750	480	3	215	13.5	66%	
SHWP-23	[illegible]	IN-LINE	560	188	40	1750	480	3	215	13.5	66%	
TSHWP-1	THERMAL STORAGE [illegible] PUMP	IN-LINE	265	20	1 1/2	1750	480	3	500	5.5	55%	
TSHWP-2 TSHWP-2A	THERMAL STORAGE [illegible] PUMP	IN-LINE	110	15	1	1750	480	3	500	5.6	45%	TSHWP-2A IS STAND-BY PUMP
TSHWP-3 TSHWP-3A	THERMAL STORAGE HOT WATER PUMP	IN-LINE	[illegible]	25	1/2	1750	480	3	500	5.2	50%	TSHWP-3A IS STAND-BY PUMP
TSHWP-4 TSHWP-4A	THERMAL STORAGE [illegible] PUMP	IN-LINE	167	15	1 1/2	1750	480	3	500	5.5	55%	TSHWP-4A IS STAND-BY PUMP
HWP-1	[illegible]	IN-LINE	180	25	2	1750	480	3	215	6.5	76%	
HWP-2	[illegible] PUMP	IN-LINE	81	20	3/4	1750	480	3	223	5.2	58%	
HWP-3	OIL COOLER PUMP	IN-LINE	156	60	7 1/2	1750	480	3	150	8.75	75%	
HWP-4	OIL COOLER PUMP	IN-LINE	156	60	7 1/2	1750	480	3	150	8.75	75%	
HWP-5	OIL COOLER PUMP STAND-BY	IN-LINE	156	60	7 1/2	1750	480	3	150	8.75	75%	
CTP-1	COOLING TOWER PUMP FOR CH-1	BASE MOUNTED	2240	50	30	1150	480	3	85	11.75	79%	
CTP-2	COOLING TOWER PUMP FOR CH-2	BASE MOUNTED	[illegible]	50	7 1/2	1750	480	3	85	10.75	75%	
CTP-3	COOLING TOWER STAND-BY PUMP	BASE MOUNTED	2240	50	30	1150	480	3	85	11.75	74%	
CHWP-1 CHWP-2	CHILLED WATER PUMP	BASE MOUNTED	1870	162	100	1750	480	3	56	[illegible]	80%	CHWP-2 IS STAND-BY PUMP
PCHWP-1 PCHWP-3	PRIMARY CHILLED WATER PUMP	IN-LINE	358	25	15	1150	480	3	56	10.3	70%	SERVICE TO CH-1 PCHWP-3 IS STAND-BY PUMP
PCHWP-2	PRIMARY CHILLED WATER PUMP	IN-LINE	260	25	3	1750	480	3	56	7.1	70%	SERVICE TO CH-2
DOP-1 DOP-2	DIESEL OIL PUMP	BASE MOUNTED	30	44	1	1750	480	3	50	GEAR PUMP	—	DOP-2 IS STAND-BY PUMP
ACWP-1 ACWP-2	AFTER COOLER PUMP	IN-LINE	480	50	10	1750	480	3	120	8.7	73%	ACWP-2 IS STAND-BY PUMP
LOP-1 LOP-2	LUBE OIL PUMP	BASE MOUNTED	7	61	1	1750	480	3	50	GEAR PUMP	—	LOP-2 IS STAND-BY PUMP
CTFP-1	COOLING TOWER [illegible]	IN-LINE	80	72	5	1750	480	3	85	8.5	45%	
HP-1	HOUSE PUMP DUPLEX	BASE MOUNTED	110	125	(2) 7 1/2	3500	480	3	60	5.5	67%	CONSTANT PRESSURE SYSTEM

* MOTOR HP'S BASED ON ASSUMED ESTIMATED TOTAL HEAD

EQUIPMENT SCHEDULE CONTINUATION

NUMBER	DESCRIPTION
CT-1	COOLING TOWER: CAPACITY 1276 GPM, EWT 101.5°F, LWT 85°F, WB 77°F, 230400 CFM FANS AT [illegible] (3) 40 HP 480/3/60 HZ 1750 RPM MOTORS
B1 B2 B3 B4 STAND-BY	HOT WATER BOILERS [illegible]: CAPACITY 6559.6 MBH OUTLET, BURNER TO BURN DIESEL FUEL OIL [illegible] SHALL BE FULL MODULATION WITH LOW FIRE START [illegible] TO PUMP [illegible] RELIEF VALVE ASME LABEL [illegible] CONTROL CIRCUIT
AC-1 AC-2	AIR COMPRESSOR [illegible]: [illegible] 250 PSIG [illegible] MOTOR [illegible] COMPLETE WITH 2 PRESSURE SWITCHES [illegible] FILTER SILENCER [illegible] AFTER COOLER [illegible] AUTO TRAP WATER REGULATING [illegible] SYSTEM, AFTER COOLER TO UNLOADER
DOST-1 DOST-2	DIESEL OIL STORAGE TANK (UNDERGROUND): CAPACITY 25,000 GAL [illegible] COMPLETE WITH [illegible] MANHOLE [illegible] APPROVED [illegible] MASTIC PRIMER [illegible] BITUMASTIC [illegible] REINFORCED CONCRETE HOLD DOWN SLAB
LOST-1	LUBRICATING OIL STORAGE TANK (UNDERGROUND): [illegible] FOR CONT OF SPEC
LOSWT-1	LUBRICATING OIL STORAGE WASTE TANK [illegible]: [illegible] SEE CONT OF SPEC
DODT-1 DODT-2	DIESEL OIL STORAGE DAY TANK: CAPACITY 1000 GAL [illegible] COMPLETE WITH GAUGE GLASS WITH GUARDS, PIPE OPENINGS AND UL APPROVED
DOCT-1	DIESEL OIL CHARGING TANK: SAME AS DOST-1

SEE SHEET SKM-10 FOR CONTINUATION

MARK	DESCRIPTION	DATE	APPROVAL

REVISIONS

GANZE - KORODKIN - CALOGER INC
DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON, D.C.

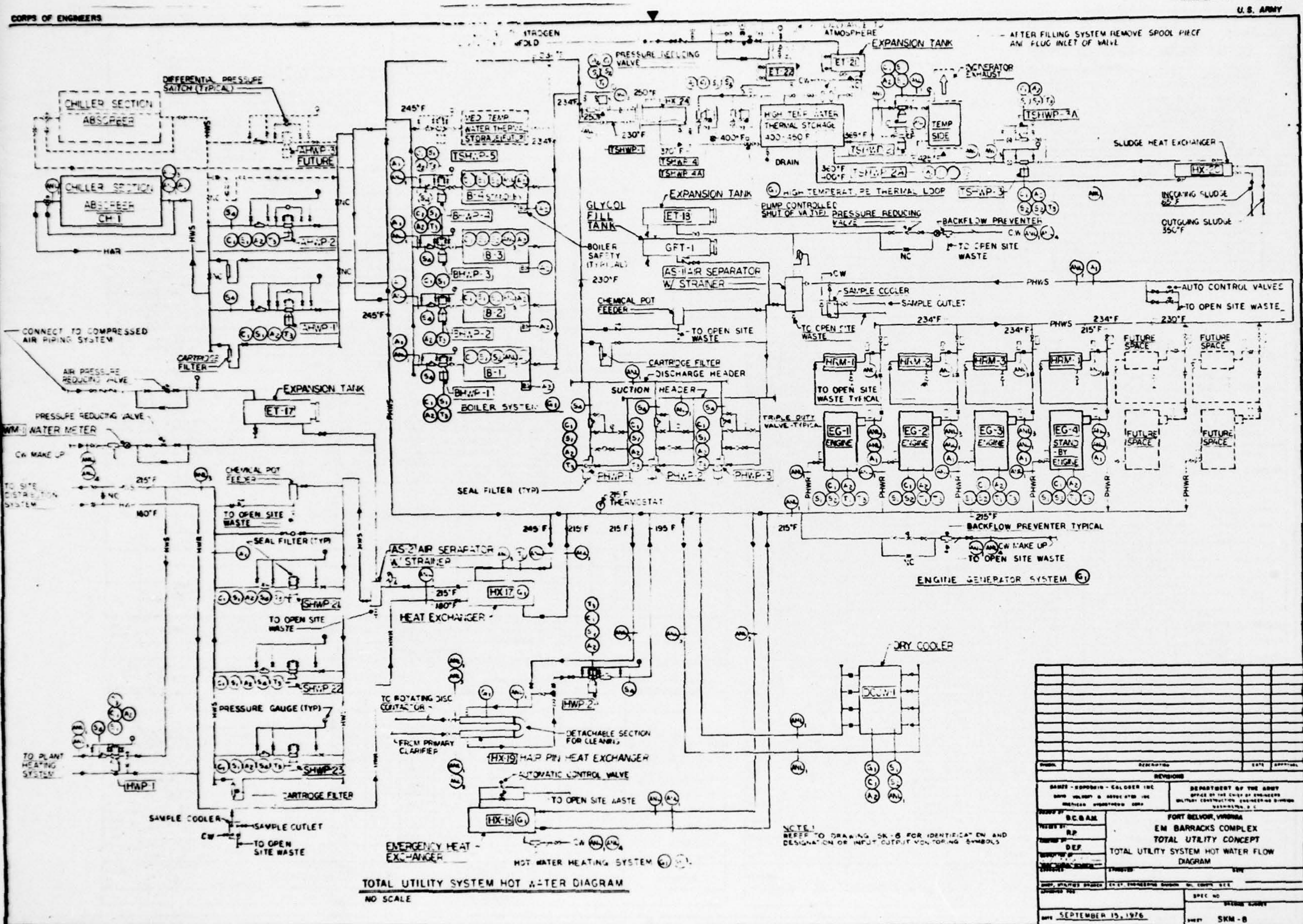
DRAWN BY: B.C.
TRACED BY: B.C.
CHECKED BY: D.E.F.

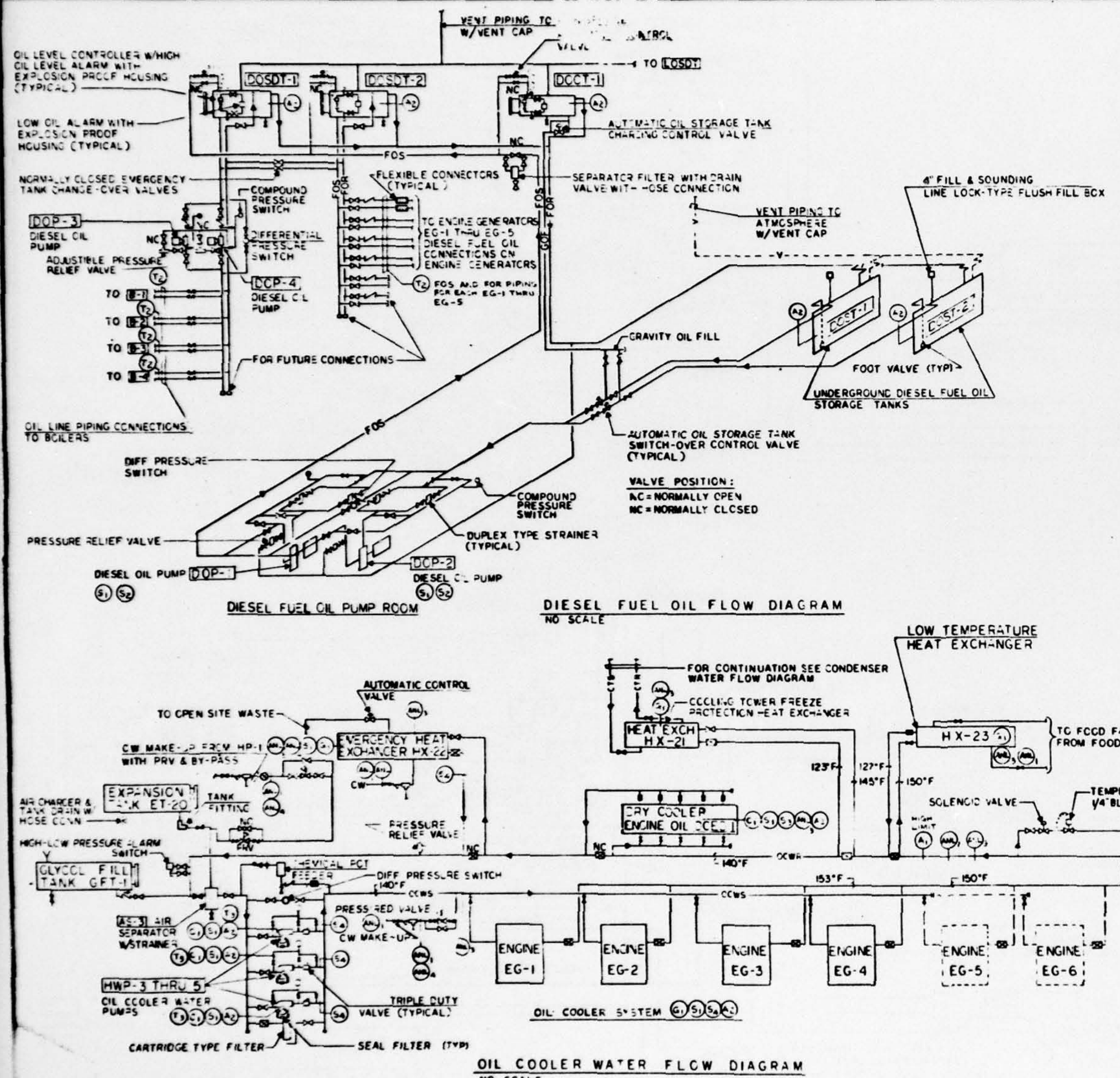
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
MECHANICAL SCHEDULES FOR TOTAL UTILITY SYSTEM BUILDING

APPROVED: CHIEF, UTILITIES BRANCH — APPROVED: CHIEF, ENGINEERING DIVISION — DATE

APPROVED FOR — SPEC NO

DATE: SEPTEMBER 15, 1976 — SHEET SKM-7


CORPS OF ENGINEERS
U.S. ARMY
CHILLER SECTION ABSORBER
CHILLER SECTION ABSORBER CH-1
DIFFERENTIAL PRESSURE SWITCH (TYPICAL)
CONNECT TO COMPRESSED AIR PIPING SYSTEM
AIR PRESSURE REDUCING VALVE
CARTRIDGE FILTER
EXPANSION TANK
ET-17
PRESSURE REDUCING VALVE
WM-1 WATER METER
CW MAKE UP
TO SITE DISTRIBUTION SYSTEM
CHEMICAL POT FEEDER
TO OPEN SITE WASTE
SEAL FILTER (TYP)
SHWP 21
SHWP 22
SHWP 23
PRESSURE GAUGE (TYP)
CARTRIDGE FILTER
TO PLANT HEATING SYSTEM
HWP 1
SAMPLE COOLER
SAMPLE OUTLET
TO OPEN SITE WASTE
BOILER SYSTEM
BOILER SAFETY (TYPICAL)
GLYCOL FILL TANK
EXPANSION TANK
ET-18
GFT-1
AS-1 AIR SEPARATOR W/ STRAINER
CHEMICAL POT FEEDER
CARTRIDGE FILTER
DISCHARGE HEADER
SUCTION HEADER
TRIPLE DUTY VALVE-TYPICAL
SEAL FILTER (TYP)
THERMOSTAT
AS-2 AIR SEPARATOR & STRAINER
HX-17
HEAT EXCHANGER
TO ROTATING DISC CONTACTOR
FROM PRIMARY CLARIFIER
DETACHABLE SECTION FOR CLEANING
HX-19 HAIR PIN HEAT EXCHANGER
HWP 2
AUTOMATIC CONTROL VALVE
TO OPEN SITE WASTE
HX-16
EMERGENCY HEAT EXCHANGER
HOT WATER HEATING SYSTEM
TOTAL UTILITY SYSTEM HOT WATER DIAGRAM
NO SCALE
HIGH TEMP WATER THERMAL STORAGE 400-450 F
MED TEMP WATER THERMAL STORAGE
DRAIN
HIGH TEMPERATURE THERMAL LOOP
PUMP CONTROLLED SHUT OF VALVE
PRESSURE REDUCING VALVE
BACKFLOW PREVENTER
TO OPEN SITE WASTE
EXPANSION TANK
ET-20
ET-22
GENERATOR EXHAUST
TEMP SIDE
SLUDGE HEAT EXCHANGER
INCOMING SLUDGE
OUTGOING SLUDGE 350°F
AFTER FILLING SYSTEM REMOVE SPOOL PIECE AND PLUG INLET OF VALVE
SAMPLE COOLER
SAMPLE OUTLET
AUTO CONTROL VALVES
TO OPEN SITE WASTE
TO OPEN SITE WASTE TYPICAL
EG-1 ENGINE
EG-2 ENGINE
EG-3 ENGINE
EG-4 STAND-BY ENGINE
FUTURE SPACE
BACKFLOW PREVENTER TYPICAL
CW MAKE UP
TO OPEN SITE WASTE
ENGINE GENERATOR SYSTEM
DRY COOLER
NOTE 1. REFER TO DRAWING SK-6 FOR IDENTIFICATION AND DESIGNATION OF INPUT OUTPUT MONITORING SYMBOLS
REVISIONS
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
TOTAL UTILITY SYSTEM HOT WATER FLOW DIAGRAM
SEPTEMBER 15, 1976
SKM-8



INPUT/OUTPUT MONITORING POINT IDENTIFICATION SYMBOL		
MARK	DATA TYPE	SYSTEM DESCRIPTION
G_1	GENERAL	GRAPHIC
G_2	GENERAL	INTERCOM
C_1	COMMANDS	START - STOP
C_2	COMMANDS	CPA OR EPA
C_3	COMMANDS	TIME PROGRAM
S_1	STATUS	STATUS INDICATOR
S_2	STATUS	AUXILIARY CONTACTOR (INPUT SOURCE)
S_3	STATUS	DIFFERENTIAL PRESSURE (INPUT SOURCE)
S_4	STATUS	FLOW SWITCH (INPUT SOURCE)
ANL_1	ANALOG INDICATION	TEMPERATURE
ANL_2	ANALOG INDICATION	HUMIDITY
ANL_3	ANALOG INDICATION	BTUH OR TONS
ANL_4	ANALOG INDICATION	PSI
A_1	ALARMS	ANALOG
A_2	ALARMS	CRITICAL
A_3	ALARMS	SUPERVISED
A_4	ALARMS	MAINTENANCE
T_1	TOTALS	RUN TIME
T_2	TOTALS	GPM
T_3	TOTALS	KW/HR

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS

FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
DIESEL FUEL OIL AND OIL COOLER FLOW DIAGRAM

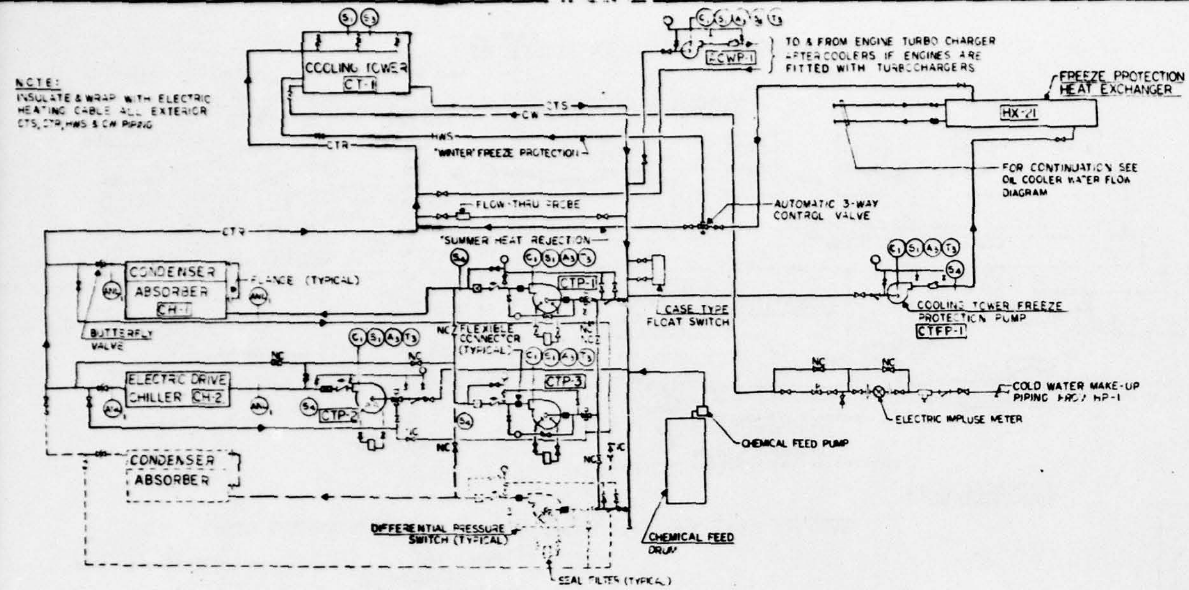
DESIGNED BY A.M.
DRAWN BY A.M.
CHECKED BY D.E.F.

DATE SEPTEMBER 15, 1976
SHEET SIM-9

CORPS OF ENGINEERS

U.S. ARMY

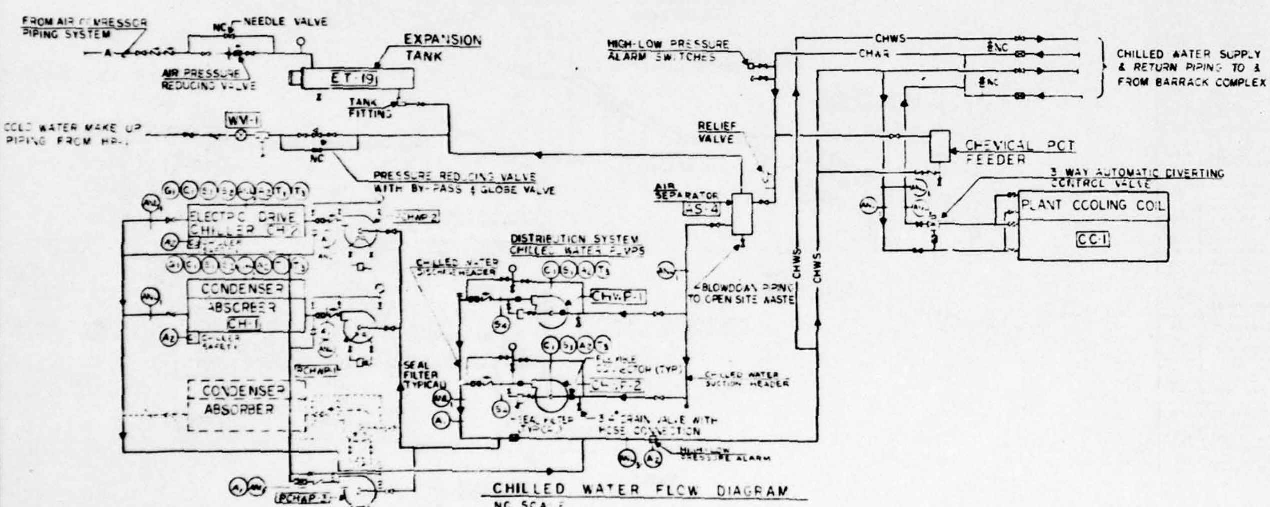
NOTE:
INSULATE & WRAP WITH ELECTRIC HEATING CABLE ALL EXTERIOR CTS, CTR, HWS & CW PIPING



CONDENSER WATER FLOW DIAGRAM
NO SCALE

	EQUIPMENT SCHEDULE
CC-1	COOLING COIL (S-1 UNIT) 53000 CFM 650 FPM FACE VEL [illegible] MBH WITH 95°F EDB, [illegible] EWB, 77°F LDB, 72°F LWB 45°F EWT 56°F LWT AT 194 GPM WATER SIDE PD 4 FT. AIR SIDE PD .75"
HC-1	HEATING COIL (S-1 UNIT) 53,000 CFM 650 FPM FACE VEL. [illegible] MBH WITH 0°F EDB, 50°F LDB 215°F EWT 185°F LWT AT 40 GPM, WATER SIDE PD 3.5 FT. AIR SIDE PD .5"
M-1 M-2 M-3 M-4	MUFFLERS RESIDENTIAL QUALITY EXHAUST SILENCER
AT-1 AT-2	AIR TANK CAPACITY: 51 CU FT 36 DIA x 8'-0" LONG, 250 PSI WORKING PRESSURE, ASME STAMPED, COMPLETE WITH PIPING CONNECTIONS AS SHOWN, AUTO. TANK DRAINER AND ASME SAFETY RELIEF VALVES.
FC-1	FAN COIL UNIT COOLING CAPACITY: 600 CFM, 17.0 MBH, 3.5 GPM, 12.0 PD, EDB 80°F, LDB 67°F, EWT 45°F, LWT 55°F, FAN MOTOR 100 WATTS @ 120V. FLOOR TYPE UNIT WITH 3 SPEED FAN CONTROL, VERTICAL DISCHARGE GRILL, DRAIN PAN, VALVE ACCESS DOORS AND FILTER
EWH-1	ELECTRIC WATER HEATER CAPACITY: 20 GAL., 3 KW, 208 V, SINGLE PHASE - 60 HZ, RECOVERY RATE AT 12 GPH AT 100°F TEMP. RISE, COMPLETE WITH JUCTION BOX, HIGH LIMIT WATER TEMP. CUT-OFF AND WATER TEMP CONTROL, ANODIC PROTECTION, DRAIN VALVE AND CONFORM TO [illegible] STANDARD AND BE UL LISTED
TST-1	THERMAL STORAGE TANK CAPACITY: 20,000 GAL., 120 DIA x 34'-2 LONG COMPLETE WITH ASME LABEL, PIPE OPENINGS AS SHOWN ON DRAWINGS. DESIGN RATING OF TANK SHALL BE 500°F AT 666 PSIG
EG-1 EG-2 EG-3 EG-4 STAND-BY	ENGINE GENERATOR 860 BHP OUTPUT 600 KW JACKET WATER 333.5 GPM AT 20 PD JACKET HEAT RECOVERY 1,505.9 MBH [illegible] OIL COOLER HEAT RECOVERY 390.2 MBH AFTER COOLER HEAT RECOVERY 40.2 MBH ENGINE TO OPERATE ON DIESEL FUEL OIL
	SEE SHEET SKM-7 FOR CONTINUATION

NOTE:
REFER TO DRAWING SKM-9 FOR IDENTIFICATION OF INPUT/OUTPUT MONITORING SYMBOLS



CHILLED WATER FLOW DIAGRAM
NO SCALE

BEST AVAILABLE COPY

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

GANZE - KONOPKIN - CALOGER INC
[illegible] VOLKOFF & ASSOCIATES INC
AMERICAN HYDROTHERM CORP

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON, D.C.

DRAWN BY D.C.G.A.M.
CHECKED BY D.E.F.

FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
CHILLED WATER AND CONDENSER WATER FLOW DIAGRAM

APPROVED
CHIEF, UTILITIES BRANCH
CHIEF, ENGINEERING DIVISION
DATE

SPEC NO

DATE SEPTEMBER 15, 1976
SHEET SKM-10

CORPS OF ENGINEERS

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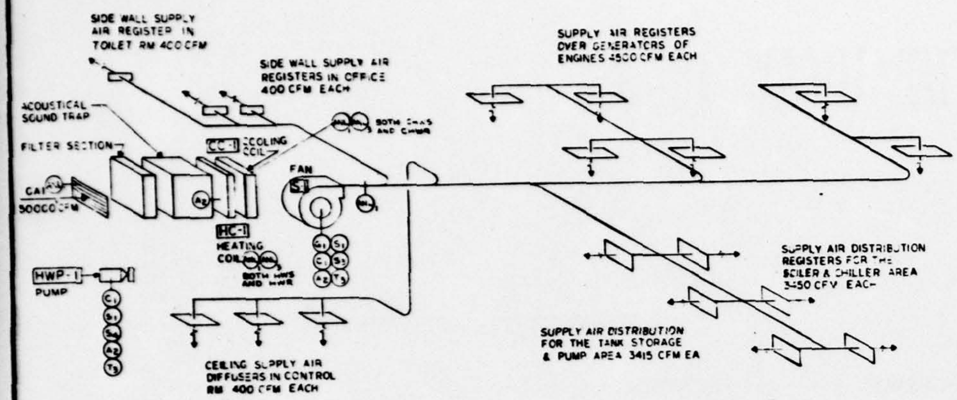
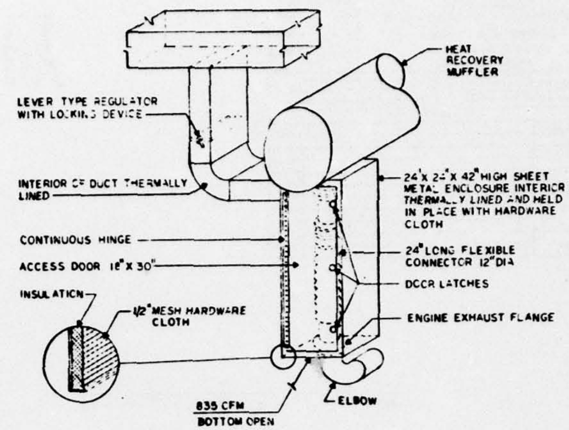


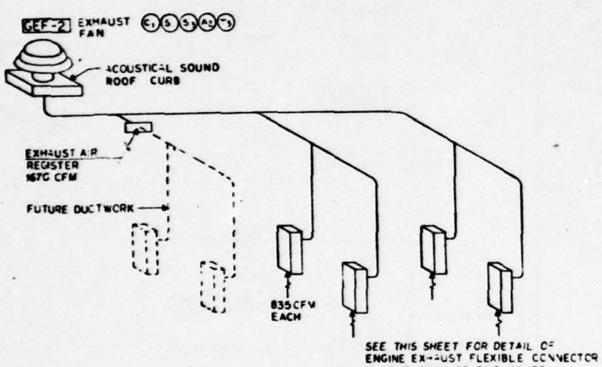
HVAC AIR FLOW DIAGRAM

NO SCALE



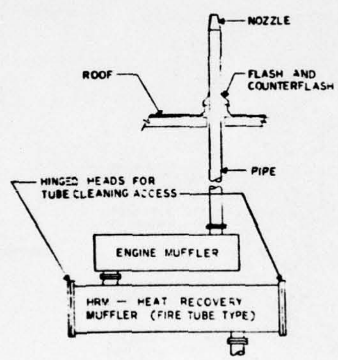
TYPICAL DETAIL OF ENGINE EXHAUST FLEXIBLE CONNECTOR AND HEAT EXHAUST ENCLOSURE

NO SCALE



HEAT EXHAUST ENCLOSURE AIR FLOW DIAGRAM

NO SCALE



TYPICAL DETAIL OF ENGINE EXHAUST

NO SCALE

NOTE:
REFER TO DRAWING IKM-9 FOR IDENTIFICATION AND DESIGNATION OF INPUT/OUTPUT MONITORING SYMBOLS

REVISIONS

GANZE - KOROSKIN - SALOGER INC

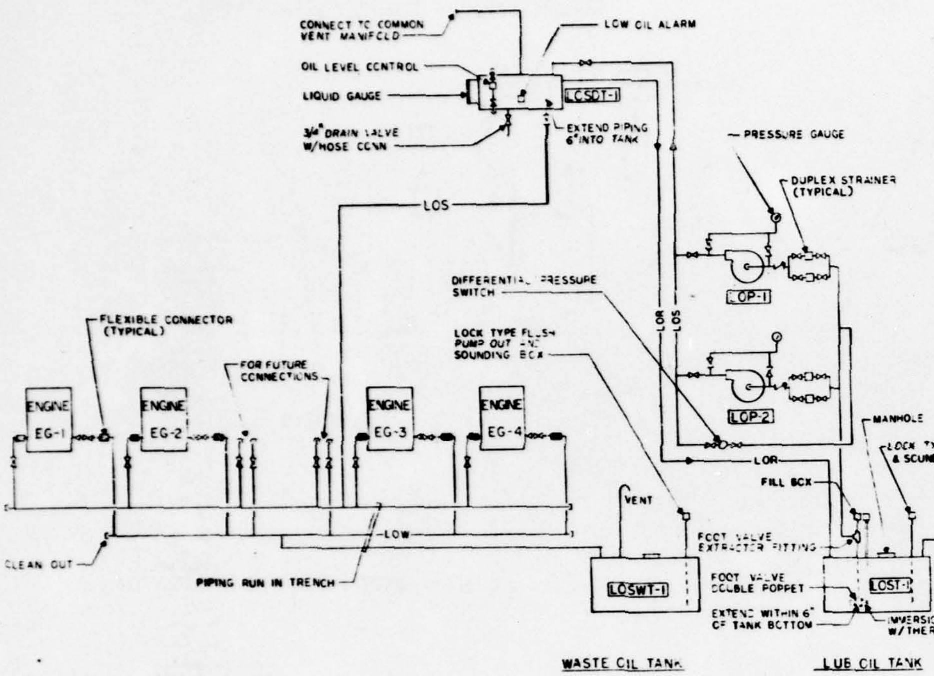
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS

FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SUPPLY AIR AND EXHAUST
AIR FLOW DIAGRAMS

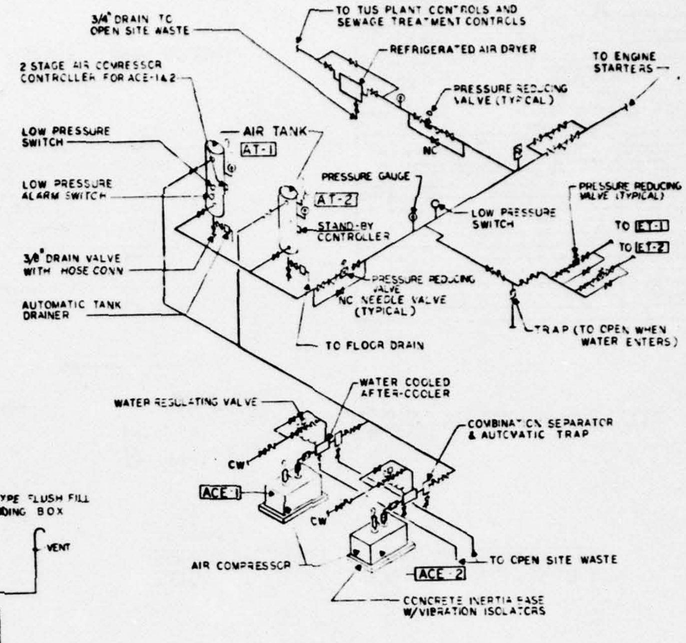
DRAWN BY: A.M.
TRACED BY: A.M.
CHECKED BY: DEF

DATE: SEPTEMBER 17, 1976

SHEET: SIGM-11



LUBRICATING OIL FLOW DIAGRAM
NO SCALE



COMPRESSED AIR FLOW DIAGRAM
NO SCALE

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

GANZE - ROROSKIN - CALOGER INC
ROYD VOLKERT & ASSOCIATED INC
AMERICAN HYDROTHERM CORP

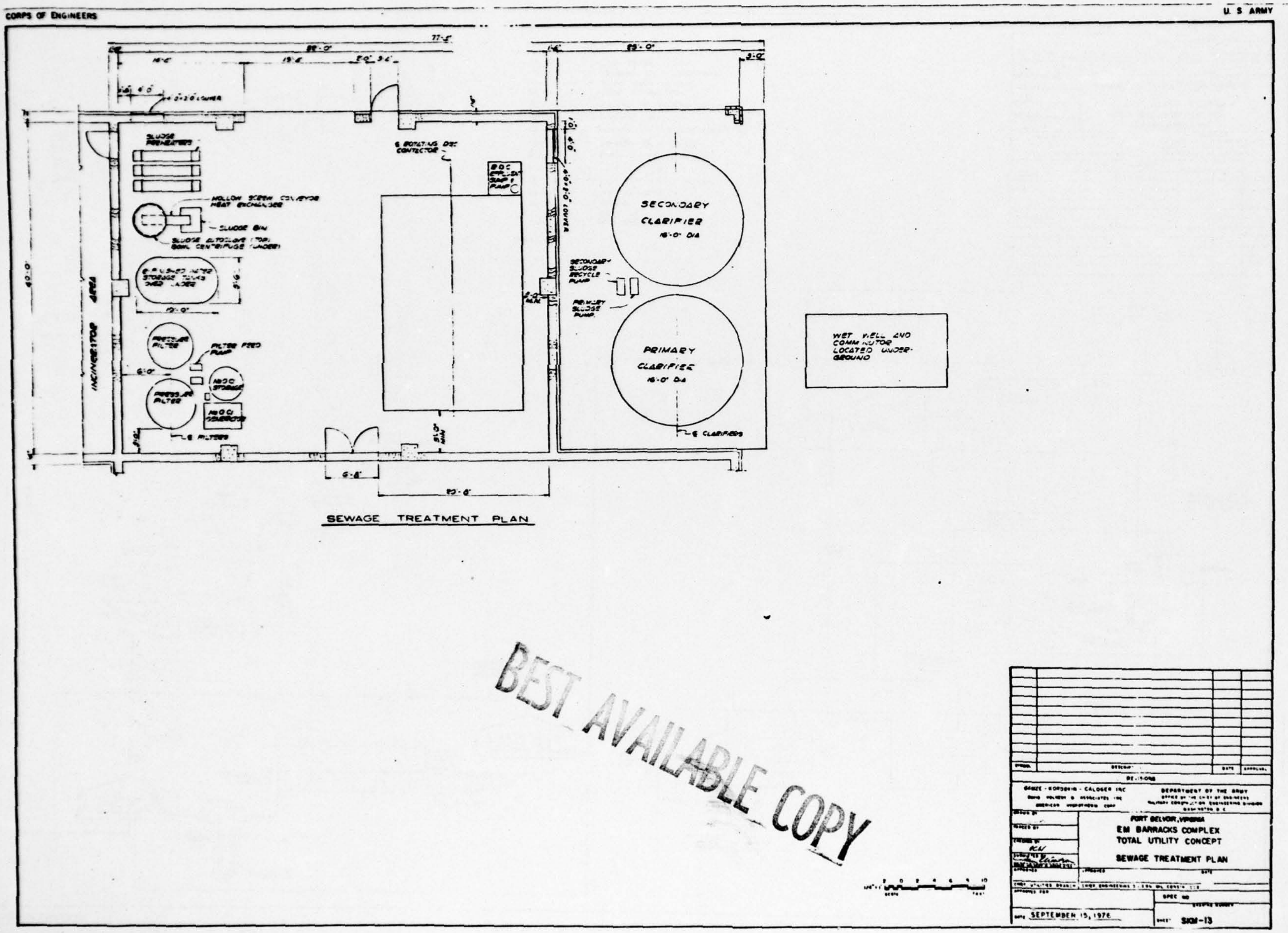
DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON D.C.

DESIGNED BY: A N
DRAWN BY: A N
CHECKED BY: DEF

FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
LUBRICATING OIL AND COMPRESSED AIR FLOW DIAGRAM

APPROVED: CHIEF, UTILITIES BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION
DATE

APPROVED FOR
SPEC NO
DATE SEPTEMBER 15, 1976
SHEET SKM-12


CORPS OF ENGINEERS
U S ARMY
SEWAGE TREATMENT PLAN
SLUDGE PREHEATERS
HOLLOW SCREW CONVEYOR HEAT EXCHANGER
SLUDGE BIN
SLUDGE AUTOCLAVE (TOP) BOWL CENTRIFUGE (UNDER)
PRESSURE FILTER
FILTER FEED PUMP
INCINERATOR AREA
ROTATING DISC CONTACTOR
SECONDARY CLARIFIER 16'-0" DIA
PRIMARY CLARIFIER 16'-0" DIA
SECONDARY SLUDGE RECYCLE PUMP
PRIMARY SLUDGE PUMP
CLARIFIERS
WET WELL AND COMMINUTOR LOCATED UNDER-GROUND
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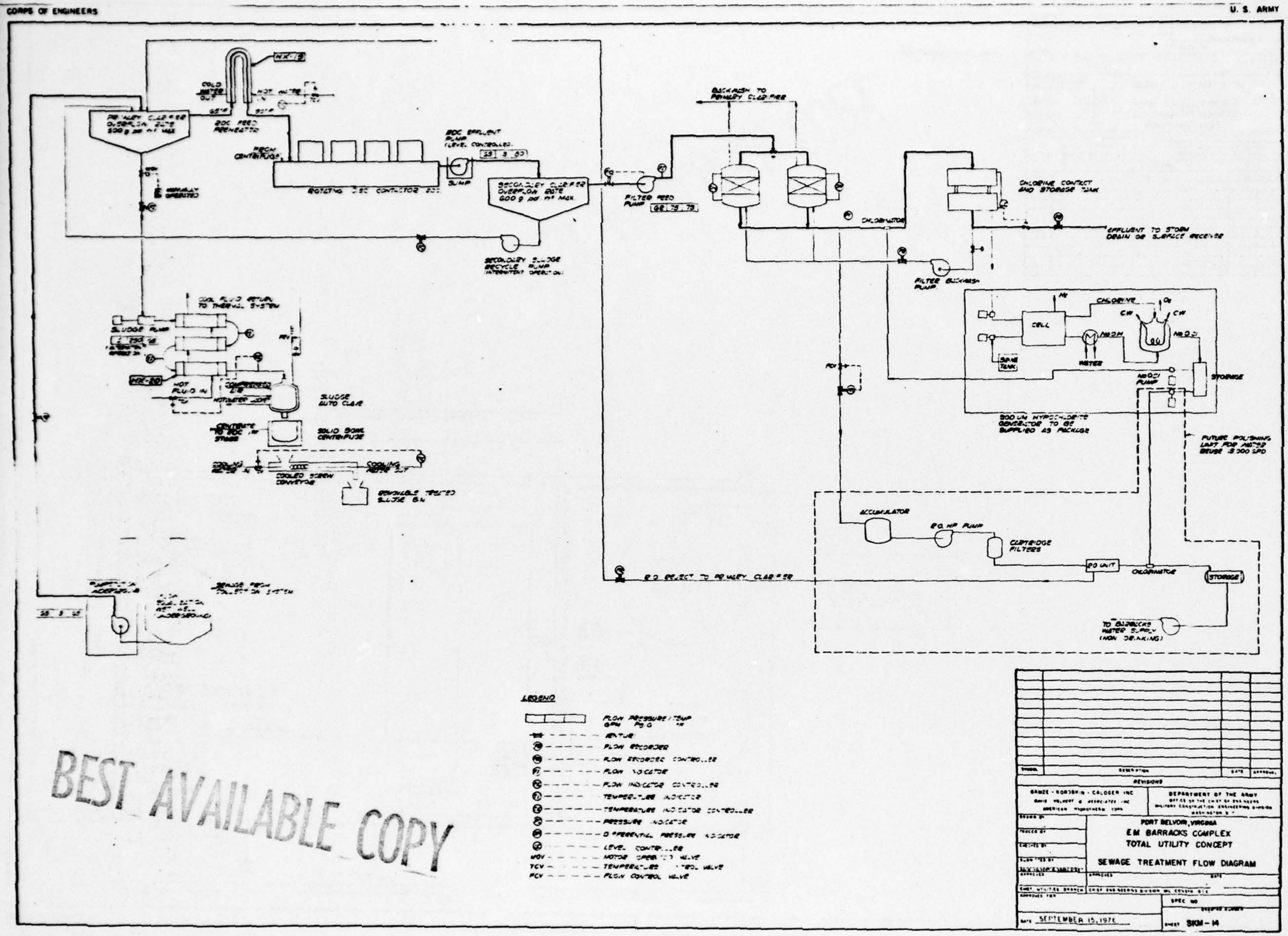
REVISIONS
DEPARTMENT OF THE ARMY
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SEWAGE TREATMENT PLAN
SEPTEMBER 15, 1976
SKM-13


CORPS OF ENGINEERS
U. S. ARMY
PRIMARY CLARIFIER
SECONDARY CLARIFIER
ROTATING DISC CONTACTOR
SUMP
FILTER FEED PUMP
CHLORINATOR
CHLORINE CONTACT AND STORAGE TANK
FILTER BACKWASH PUMP
CELL
CHLORINE
STORAGE
ACCUMULATOR
R.O. HP PUMP
CARTRIDGE FILTERS
RO UNIT
TO BARRACKS WATER SUPPLY (NON DRINKING)
R.O. REJECT TO PRIMARY CLARIFIER
SLUDGE AUTO CLAVE
SOLID BOWL CENTRIFUGE
COOLED SCREW CONVEYOR
LEGEND
FLOW RECORDER
FLOW INDICATOR
PRESSURE INDICATOR
FLOW CONTROL VALVE
REVISIONS
GANZE - KORDBRIN - CALOGER INC
DEPARTMENT OF THE ARMY
PORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SEWAGE TREATMENT FLOW DIAGRAM
SPEC NO
DATE SEPTEMBER 15, 1976
SHEET SKM-14

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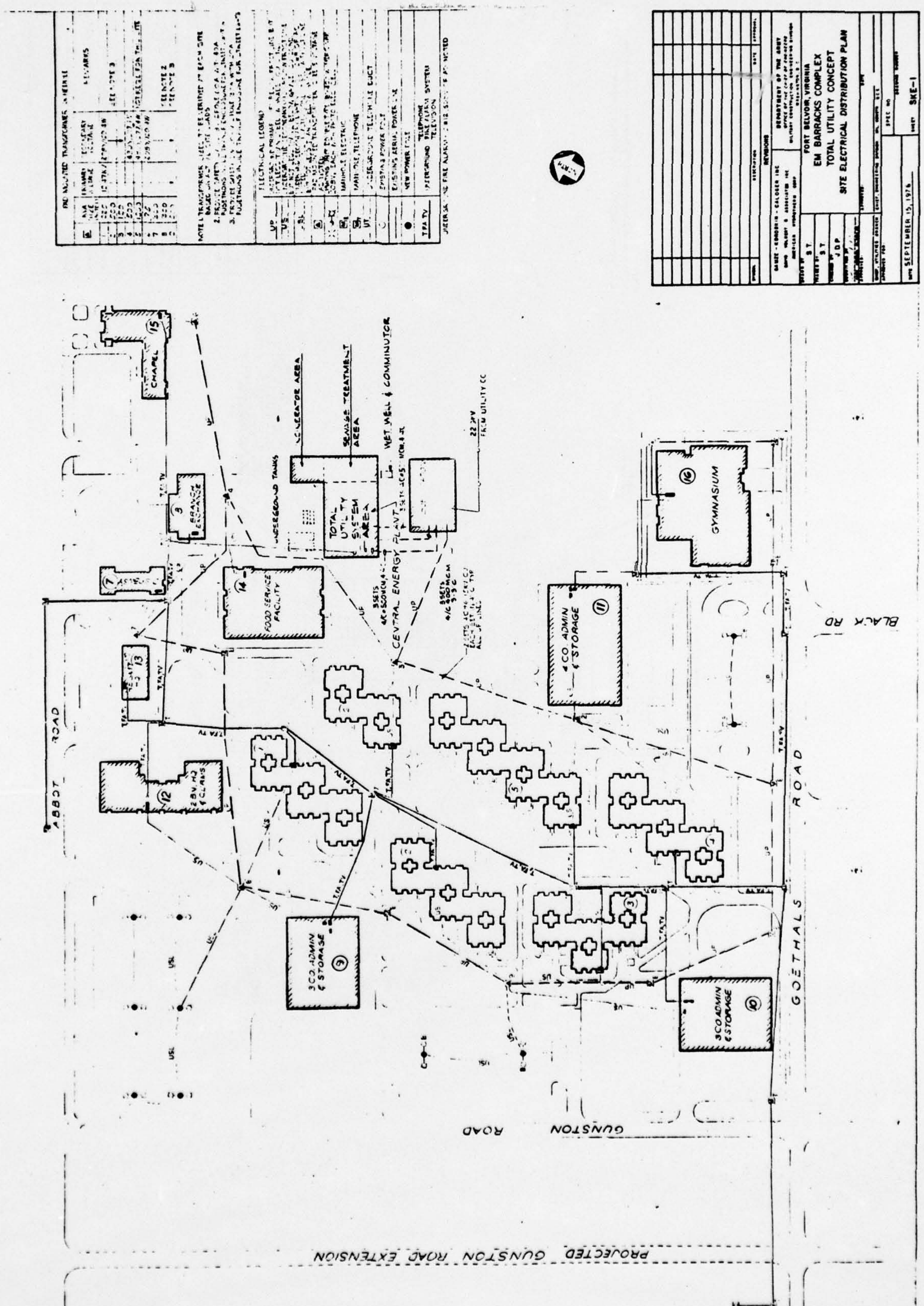

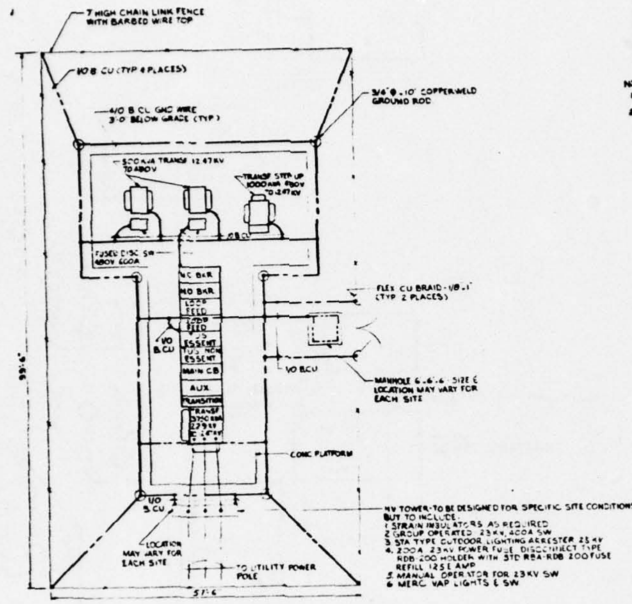

SUBSTATION LAYOUT & GROUNDING
SCALE 1/8" = 1'-0"

NOTES:
1. GROUNDING RODS TO BE INSTALLED IN APPROXIMATE LOCATIONS SHOWN
2. ALL GROUND CONNECTIONS TO BE EXOTHERMIC WELDS

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

GAMZE - KOROBKIN - CALOGER INC

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C.

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FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
ELECTRICAL SUBSTATION PLAN

APPROVED:
CHIEF, UTILITIES BRANCH
APPROVED:
CHIEF, ENGINEERING DIVISION
DATE

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DATE SEPTEMBER 15, 1976
SHEET SKE-2

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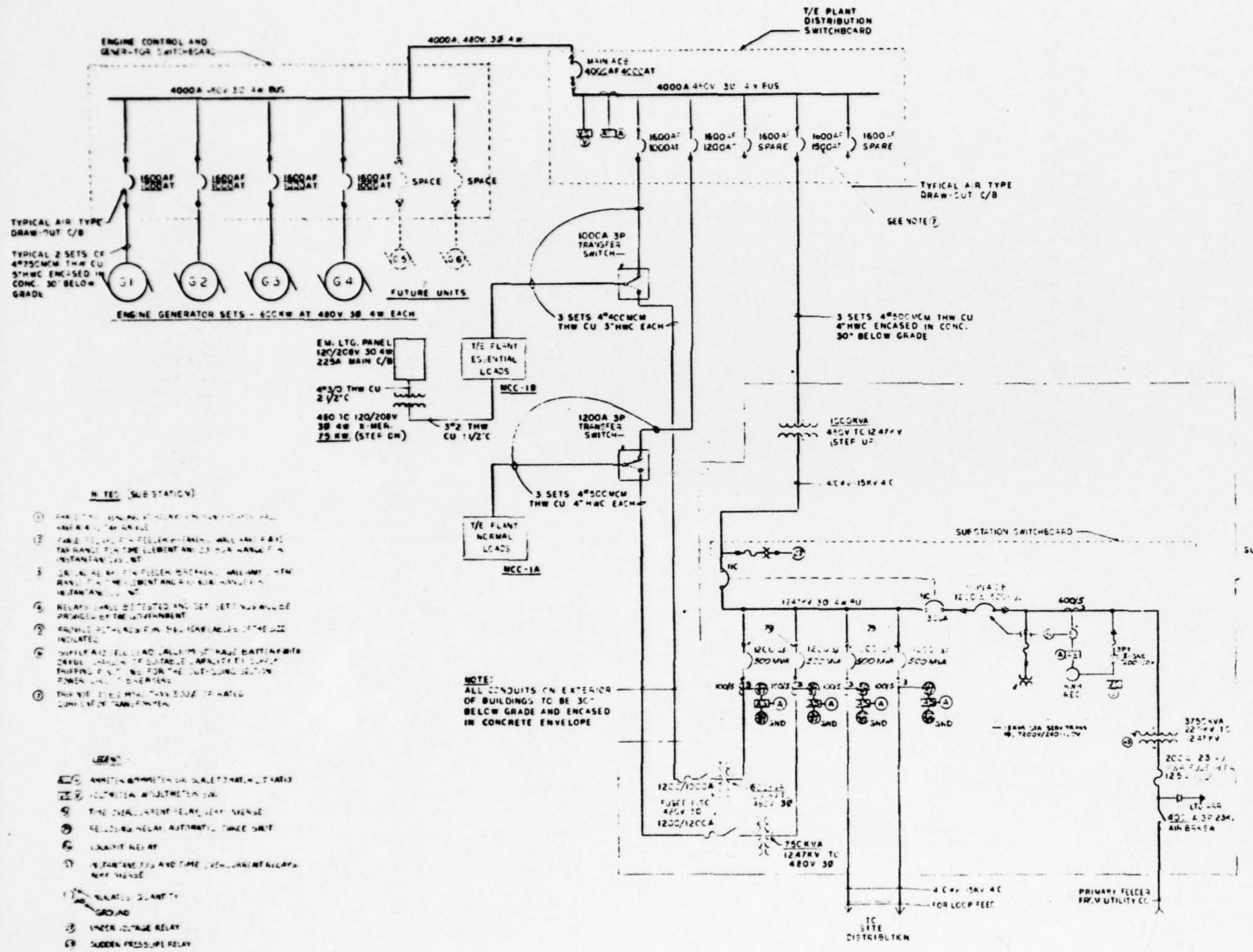

SYMBOL	DESCRIPTION		DATE	APPROVAL

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DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON, D.C.

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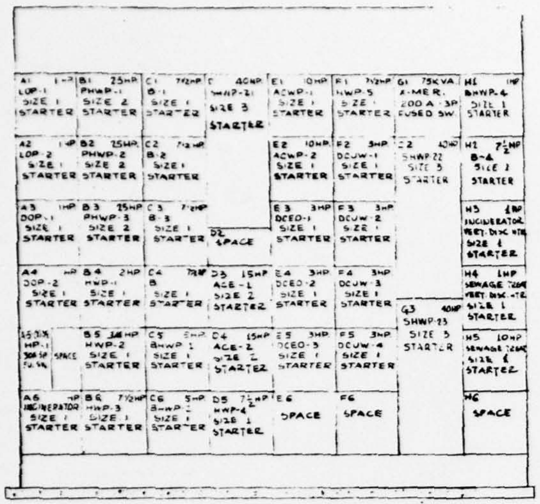
FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT
SINGLE LINE RISER DIAGRAM

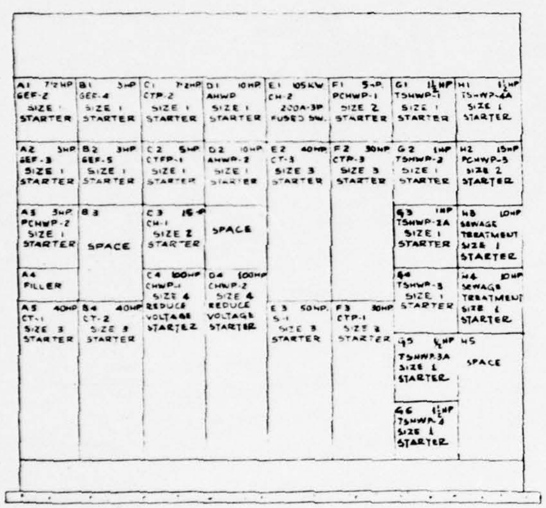
DATE SEPTEMBER 15, 1976
SHEET SKE-3

CORPS OF ENGINEERS

U S ARMY



MCC -1B ESSENTIAL



MCC - 1A NORMAL

SYMBOLS LIST

- MOTOR OUTLET.
- MOTOR CONTROL CENTRAL.
- DRAWOUT TYPE POWER CIRCUIT BREAKER.
- MOLDED CASE CIRCUIT BREAKER.
- TRANSFORMER.
- CONTACTOR.
- RELAY.
- NON-FUSED SAFETY DISCONNECT SWITCH.
- FUSED SAFETY DISCONNECT SWITCH.
- EQUIPMENT CONTROL PANEL.
- FUSE.
- INDICATING LIGHT.
- TRANSFORMER.
- GROUND.
- COIL.
- NORMALLY OPEN CONTACT.
- NORMALLY CLOSED CONTACT.
- PUSH BUTTON.
- THERMOSTAT.
- MAGNETIC MOTOR STARTER.
- FRACTIONAL HORSE POWER MOTOR STARTER.

LEGEND

CT	CURRENT TRANSFORMER.
PT	POTENTIAL TRANSFORMER.
V	A.C. VOLTMETER.
A	A.C. AMMETER.
WM	A.C. WATTHOUR METER.
TS	TEST SWITCH.
AS	AMMETER SWITCH.
VS	VOLTMETER SWITCH.
GFP	GROUND FAULT PROTECTION.
GFI	GROUND FAULT INDICATOR.
NO	NORMALLY OPEN.
NC	NORMALLY CLOSED.

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EQUIPMENT INTERFACE SCHEDULE

SEE DWGS SK-2 AND SK-3

	EQUIPMENT TO BE DISCONNECT					EQUIPMENT TO BE WIRED				
BLDG. NO.	EQUIPMENT	H.P.	VOLT	PHASE	EXISTING PROTECTION	EQUIPMENT	HP	VOLT	PHASE	NEW PROTECTION
1	CONDENSATE PUMP	2-1/2	208	3		DHWP-1	1/4	120	1	MS
						SHWP-1	3/4	208	3	
2						DHWP-2	1/4	120	1	MS
						SHWP-2	3/4	208	3	
3						DHWP-3	1/4	120	1	MS
						SHWP-3	3/4	208	3	
4						DHWP-4	1/4	120	1	MS
						SHWP-4	3/4	208	3	
5						DHWP-5	1/3	120	1	MS
						SHWP-5	1/2	208	3	
6						DHWP-6	1/4	120		MS
						SHWP-6	1/2	120	1	
7						SHWP-7	1/4	120	1	
8	CONDENSATE PUMP	2-1/2	208	3		SHWP-8	1/4	120	1	
9						SHWP-9	1/4	120	1	
						SHWP-17	3/4	208	3	
10						SHWP-10	1/4	120	1	MS
						SHWP-18	3/4	208	3	
11						SHWP-11	1/4	120	1	MS
						SHWP-19		208	3	
12						SHWP-12	2	120	1	MS
13						SHWP-13	1/4	120	1	
14						SHWP-14	2	208	3	
						DHWP-7	2	120	1	MS
						SHWP-20	5	208	3	
15						SHWP-15	1/4	120	1	MS
16						SHWP-16	2	208	3	
						DHWP-8	1/3	120	1	MS

SYMBOL	DESCRIPTION	DATE	APPROVAL

REVISIONS

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DAVID VOLKERT & ASSOCIATES INC
AMERICAN HYDROTHERM CORP

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
MILITARY CONSTRUCTION ENGINEERING DIVISION
WASHINGTON, D.C.

DRAWN BY: G D
TRACED BY: G D
CHECKED BY: J D P

FORT BELVOIR, VIRGINIA
EM BARRACKS COMPLEX
TOTAL UTILITY CONCEPT

SYMBOL LIST, LEGEND AND
MOTOR CONTOL CENTERS

APPROVED: CHIEF, UTILITIES BRANCH
APPROVED: CHIEF, ENGINEERING DIVISION, MIL. CONSTN. OCE
DATE:
APPROVED FOR:
SPEC NO
DRAWING NUMBER
DATE SEPTEMBER 15, 1976
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